1955

ANNUAL REPORT

FOR THE FISCAL YEAR ENDED JUNE 30

CHIEF OF ENGINEERS
U. S. ARMY
CIVIL WORKS ACTIVITIES

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS

VOL. 1 OF TWO VOLUMES

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ANNUAL REPORT, DEPARTMENT OF THE ARMY
Fiscal Year Ended June 30, 1955

ANNUAL REPORT OF THE
CHIEF OF ENGINEERS

U. S. ARMY

ON CIVIL WORKS ACTIVITIES

1955

IN TWO VOLUMES

Vol. 1

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CONTENTS

Volume 1

Volume 2

Reports on individual project operations and related Civil Works activities published as a separate volume.

10 January 1956

SUBJECT: Annual Report on Civil Works Activities, Fiscal Year 1955.

TO: THE SECRETARY OF THE ARMY.

1. I present herewith a report for the fiscal year 1955 concerning the civil functions of the Department of the Army administered by the Chief of Engineers.

2. Civil Works activities of the Corps of Engineers include the planning, funding, construction, operation, and maintenance of works designed for navigation and flood control, including the multiple-purpose water resource developments associated therewith, as authorized by law. The first of the two volumes of my report gives a brief description and summary of the civil works portion of the responsibilities assigned to the Chief of Engineers, along with a record of accomplishments during the year. The second volume sets forth the detailed engineering, fiscal and statistical data pertaining to the various projects and phases of the authorized program. Your attention is especially invited to the major features and problems of the program outlined below that were pursued during the year.

3. Waterborne commerce of the United States continued at relatively high intensity during 1954, although some decline was experienced from the preceding year, particularly on the Great Lakes where there was a temporary leveling off of industrial production but, which, by the end of the year again took an upward trend. During fiscal year 1955 four additional navigation improvements for vessel traffic were completed, and 28 others were still under construction. Maintenance operations, such as dredging, repairs, and restoration of structures were conducted at 219 harbors and waterways, at a total cost of approximately $60,000,000. These funds were sufficient for only the barest essential needs of commerce at deep-draft harbors, on major inland waterways, and in a few lesser channels where hardships would result from nonmaintenance. Among the major navigation works under construction by the Corps of Engineers are the St. Lawrence Seaway project, under the direction of the St. Lawrence Seaway Development Corporation, and the modernization of Greenup and New Cumberland Locks and Dams which latter comprise the first units of a program for progressive improvement of navigation facilities on the Ohio River.

4. The authorized flood control program was carried forward at an accelerated rate over that of the previous year. Under the nation-

wide flood control program construction was continued on 56 projects, including 7 that were placed in useful operation. In the Alluvial Valley of the Mississippi River project a total of 74 miles of main-line levees was constructed and a length of about 30 miles of permanent revetment was placed to protect the main-stem channel. Work on the main stem of the Mississippi has reached a point where excellent protection is afforded except in some exposed backwater areas.

5. Substantial progress has been made on the Federal flood control program, but flood protection is still an urgent matter, and minimum protection is not yet available in many areas. Projects now in full or partial operation have prevented flood damages estimated at about $491 million annually, but unprevented losses of about $420 million annually still exist. In terms of actual flood experience, Federal flood control projects completed or in partial operation, during an average period of operation of about 11 years, have prevented flood damages totaling more than twice the total amount of the Federal appropriations provided for the construction of those projects.

6. Additional large multiple-purpose reservoir projects have been designed and are under construction, primarily for navigation, flood control, and the production of hydroelectric power. As indicated below, these projects often furnish important incidental benefits, including water supply, pollution abatement, increased recreational opportunities for millions of citizens, and the preservation and enhancement of fish and wildlife values. During the year, construction operations of this type were carried out on 23 projects, of which one was completed. Maintenance activities were conducted on the 28 projects already in operating status.

7. Great strides continue to be made by the Corps in constructing and operating hydroelectric power production facilities. Additional generating capacity installed during the year amounted to 643,000 kilowatts, which represents 34 percent of the hydroelectric capacity, or 4.3 percent of the total generating capacity, added to the Nation's utility systems during the year. This exceeded the amount of power added during any previous year except one. The 12.6 billion kilowatt hours of energy generated at Corps of Engineers projects represents about 11.7 percent of the hydroelectric energy and about 2.5 percent of the total energy production by all sources of electricity available to the Nation.

8. Besides serving their primary functions, reservoir projects constructed and operated by the Corps of Engineers produce many collateral benefits. Of particular importance are the water supply benefits being realized generally from the civil works program. The Corps is now providing about 940,000 acre-feet of storage space in the interest of domestic and industrial water supply in 13 reservoirs serving approximately 30 cities and towns. Also, about 3,975,000

acre-feet of storage space is being utilized, either exclusively for irrigation, or jointly for irrigation and other purposes. In numerous cases, reservoirs operated for low-flow regulation in the interest of navigation and other purposes also provide incidental multiple benefits, such as adequate water supply at downstream locations, extensive pollution abatement, increased scope for recreation, and fish and wildlife enhancement along the streams involved.

9. In view of the continued drought conditions and below-normal stream flows that prevailed over most of central and southwestern United States during the earlier months of the fiscal year, Division and District Engineers were authorized to utilize, as an emergency measure, a portion of the flood control storage in reservoirs, where feasible, to provide water storage for conservation and low-flow regulations of streams. At many locations these emergency actions relieved deficient stream flow. On the Missouri River, for instance, releases of water from Fort Peck, Garrison, and Fort Randall Reservoirs augmented natural flows to sustain desirable depths downstream of projects for navigation, municipal water supply, and pollution abatement. Similarly, reservoirs in the Southwest were operated to furnish emergency water supply for municipal and industrial use where local storage and natural flows were inadequate.

10. While substantial progress is being made on construction of the authorized civil works program, it is quite evident that the demands of the country for water resource development are forging far ahead of the funds made available for carrying out this type of work. The $339 million appropriated for construction for fiscal year 1955 was not sufficient to keep pace with the increase in funds required to complete the active civil works program. The $700 million worth of new projects authorized by the River and Harbor and Flood Control Act approved 3 September 1954, has resulted in the current backlog of justified civil works improvements that require funds reaching a total of about $8.7 billion, as compared with $8 billion in fiscal year 1954 and only $400 million in 1927. This backlog will continue to rise unless a substantially higher level of appropriations is regularly maintained.

11. The investigation program of the Corps of Engineers, which provides the basis for sound development of the Nation's water resources, was continued to the extent consistent with the funds made available by Congress for that purpose. During the year, 55 reports on proposed improvements were transmitted to Congress. In addition, comprehensive basin reports of the New England-New York and the Arkansas-White-Red Inter-Agency Committees, in both of which studies the Corps of Engineers participated, were being processed prior to transmittal to the President and the Congress.

12. Sound business management efforts have been intensified and other effective steps taken during the year to produce increased efficiency and economy. These have included improved organization and procedures and changes in working methods. One Division office was abolished, two district offices were reduced to the status of area offices, and in another district 6 area offices were reduced to 4. Also, civilian payroll handling was consolidated in a single district in each division, mechanized accounting procedures introduced or extended, and the activities of the supervisor, New York Harbor, streamlined. These organizational changes effected economies estimated at $1,580,000 annually. Improvements in accounting, statistical, and administrative procedures placed in effect, including streamlining and elimination of duplication in accounting and the results obtained from an intensified records disposal drive, produced economies estimated at $945,000 annually. Improvements in dredging efficiency produced savings upward of $1,000,000 annually. Thus, total economy measures employed during the year brought about annual savings aggregating over $3,500,000.

13. The Corps of Engineers participated extensively in various other activities pertaining to the development of national water resources policy. These include collaborating with the Presidential Advisory Committee on Water Resources Policy, the Commission on Organization of the Executive Branch of the Government (Hoover Commission), and the Inter-Agency Committee on Water Resources. Still other activities engaging the attention of the Corps of Engineers during the year are:

a. Developing regulations in cooperation with the Department of Agriculture, other agencies having a bona fide interest or responsibility, and the Bureau of the Budget, in developing methods for carrying out provisions of the Watershed Protection and Flood Control Act, Public Law 566, 83d Congress.

b. Considerations on partnership proposals for development of hydroelectric power.

c. Inter-Agency River Basin Committees for the Missouri, Columbia, and Arkansas-White-Red River Basins, and for the Pacific Southwest.

d. Foreign technical assistance program sponsored by the Department of State and the International Cooperation Administration, which included the furnishing of dredges and other heavy construction equipment, the dispatch of qualified engineers and technicians employed by the Corps to overseas countries in consulting and advisory capacities, and the training at our installations of numerous foreign nationals in our successful methods and procedures.

14. While the matter of obtaining sufficient funds to meet the nation's needs for water resources development remains as one of our

most pressing problems, I feel that the widespread attention given to needs in the field of water resources will serve to promote sound and coordinated progress on that program in future years. I look forward with confidence to the future when the cooperative efforts of all levels of Government, local organizations, and individuals will be applied to realize the ultimate objective of comprehensive water resource planning and development.

S. D. STURGIS, JR.
Lieutenant General, USA,
Chief of Engineers.

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CHAPTER I

A PROGRAM FOR WATER RESOURCES DEVELOPMENT

1. *Scope of the program.* The Civil Works program of the Corps of Engineers constitutes a major portion of the Federal plan for developing the Nation's water resources. From a modest beginning over a century ago the scope of the work has been enlarged to meet the continually growing demands of an expanding population for water uses.

Beginning with a $75,000 appropriation in 1824 for snagging and clearing the Mississippi and Ohio Rivers, the program has grown during the ensuing 131 years until today it constitutes a multimillion dollar activity, with over 3,000 projects in the 48 States, the District of Columbia, and the Territories and possessions. The work embraces projects for the improvement of the Nation's rivers and harbors for navigation, flood control, hydropower, and related purposes.

Navigation improvements at coastal and Great Lakes harbors generally involve the dredging of channels and anchorages, and frequently the protection of entrances by jetties and the creation of protected areas by breakwaters. Rivers are improved for navigation by clearing and snagging, dredging, construction of regulating works, and canalization by locks and dams. Flood control is accomplished by improving the channels of streams to increase carrying capacity, by creation of diversion channels, by construction of reservoirs for storage or detention of floodflows, and by levee and floodwall construction for protection of areas subject to damage. Projects for beach erosion control entail principally restoration of damaged areas by artificial placement of sandfill and construction of seawalls, groins, and similar structures to prevent further damage and induce beach replenishment.

Throughout the development of this extensive program, the Congress has always specified the areas to be investigated, prescribed the policies to be followed, and defined the limits of Federal participation. Congress authorizes projects individually and assigns responsibility for their construction and administration to the Secretary of the Army and the Chief of Engineers.

2. *Status of program.* Federal activity in providing navigation improvements dates back to the first River and Harbor Act, passed in 1824. The major growth of the Civil Works program has occurred since 1928, when Congress adopted the project for flood control and

navigation in the Alluvial Valley of the Mississippi and, particularly, since 1936 when Federal participation in flood control on a nationwide basis was first authorized by Congress.

As a result of successive Congressional authorizations the program has grown in magnitude until as of 30 June 1955 it included improvements completed, under construction, and not started, with a total estimated cost of $18.9 billion. This total program includes certain projects which, because of changes in economic and physical conditions since authorization, are no longer required, have been classified as inactive, as well as other projects which require further study for determination of their status. Projects in these two categories have a total estimated cost of about $3.7 billion, leaving an active program with a total estimated cost of $15.2 billion. This program is being subjected to continuing review and will be adjusted from year to year as warranted by changed conditions. The status of the active program as of 30 June 1955 was as follows:

Active Civil Works Program

Status	Number of projects or project authorizations	Millions of dollars		
		Estimated cost (1954)	Appropriations through fiscal year 1955	Required to complete
Completed or substantially completed	2,218	3,084	3,048	36
Under construction	171	6,116	3,417	2,699
Authorized, not started	695	6,032	26	6,006
Total	3,084	15,232	6,491	8,741

The backlog of active authorized work consists of those projects for which there is a current need and justification, such as the flood control work needed to protect areas where there is danger to life or possibility of heavy economic loss; navigation improvements required by a rapidly expanding economy; and hydroelectric power and water supply developments in conjunction with flood control and navigation. Other authorized projects currently assigned a lower priority require restudy because of changed physical and economic conditions since authorization, or because of an indicated lack of local interest. Most of the projects in both categories will require further detailed planning before they can be placed under construction.

3. *Organization.* The Civil Works mission of the Corps of Engineers is accomplished through a highly decentralized organization consistent with the wide geographic spread of authorized activities. This organization is comprised of 10 divisions which are subdivided into 40 districts completely covering the continental United States, Territories, and overseas possessions. Boundaries between divisions

and districts are selected so as to place, to the extent practicable, a river basin or appropriate coastal area within a single division and district, although in major basins this delineation is not always feasible.

The divisions and districts are administered by officers of the Corps of Engineers directing the work of about 25,000 civilians, exclusive of contractors' personnel, engaged in the planning, supervision of construction and operation of civil works. These field offices, together with certain additional division and district offices, also handle the military construction programs of the Army and the major portion of the Air Force program.

CHAPTER V

FUNDING TRENDS

Funds available for work. Fiscal year 1955 funds appropriated for all civil works activities of the Corps of Engineers amounted to $442,364,100. Individual appropriations are detailed in table 24. Status of the funds advanced by local interests for navigation and flood-control improvements is shown in table 25.

Table 24. Appropriations, Fiscal Year 1955

The funds with which the works for the maintenance and improvement of rivers and harbors and flood control were prosecuted during the fiscal year were derived from unexpended balances of prior appropriations and from the following appropriation acts, and by transfer from other departments:

Appropriation title	Date of act	Amount
CIVIL FUNCTIONS APPROPRIATION ACT, 1955	30 June 1954	
Flood Control, Mississippi River and Tributaries		$45,450,000.00
General Investigations, Corps of Engineers, Civil		2,907,500.00
Construction, General, Corps of Engineers, Civil		300,367,600.00
Operation and Maintenance General, Corps of Engineers, Civil.		76,110,000.00
General Expenses, Corps of Engineers, Civil, 1955		9,544,000.00
Niagara Remedial Works, Corps of Engineers, Civil		2,000,000.00
		436,379,100.00
Special Fund (Credits to Accounts from Licenses under Federal Water Power Act, 26 Aug. 1935): Maintenance and Operation of Dams and Other Improvements to Navigable Waters.	26 August 1955	304,333.56
Payments to States, Flood Control Act, 28 June 1938 as amended.	28 June 1938	1,053,144.41
SUPPLEMENTAL APPROPRIATION ACT, 1955	Approved 26 August 1954.	
Public Law 663, 83d Congress	Approved 26 August 1954.	
Construction, General, Corps of Engineers, Civil		5,985,000.00
TRUST FUNDS (Contributions):		
Rivers and Harbors, Contributed Fund	Various	6,520,248.59
FUNDS TRANSFERRED FROM OTHER DEPARTMENTS AS WORKING FUNDS:		
Working Fund, Army Engineers, Civil	do	697,806.78
Consolidated Working Fund, Army Engineers, Civil, 1953	do	−7,348.00
Consolidated Working Fund, Army Engineers, Civil, 1954	do	−48,006.29
Consolidated Working Fund, Army Engineers, Civil, 1955	do	346,412.40
Working Fund, Army Engineers, Civil (Trust Fund)	do	7,647.79
Consolidated Working Fund, Army Engineers, Civil (Special Fund), 1953–54.	do	−1,924.46
Consolidated Working Fund Army Engineers, Civil (Special Fund), 1954–55.	do	57,399.73
Capital Outlay, United States Soldiers Home (Allocated Working Fund to Corps of Engineers, Civil).	do	1,085,354.86
Military Assistance, Near East and Africa, Executive (Allocated Working Fund to Corps of Engineers, Civil), 1950–54.	do	−1,153,006.00

Table 24. Appropriations, Fiscal Year 1955—Continued

Appropriation title	Date of act	Amount
FUNDS TRANSFERRED FROM OTHER DEPARTMENTS AS WORKING FUNDS—Continued		
Repair of Reserve Fleet Facilities, Department of Commerce Maritime Administration, 1955-56 (Allocated Working Fund to Corps of Engineers, Civil).	Various	$539,000.00
Operating Expenses, Coast Guard (Allocated Working Fund to Corps of Engineers).	do	391,400.00
Construction and Rehabilitation, Bureau of Reclamation, Middle Rio Grande Project, Albuquerque, N. Mex. (Allocated Working Fund to Corps of Engineers).	do	20,000.00
Salaries and Expenses, Maritime Activities (Allocated Working Fund to Corps of Engineers, Civil), 1955.	do	368,000.00
Technical Cooperation, General Executive (Transfer to Corps of Engineers, Civil), 1955.	do	21,055.00
Defense Support, Near East, Africa and South Asia, Executive (Transfer to Corps of Engineers, Civil), 1955.	do	900.00
Total working funds		2,324,291.81
Grand total all funds		452,566,118.37

Table 25. Advanced Funds

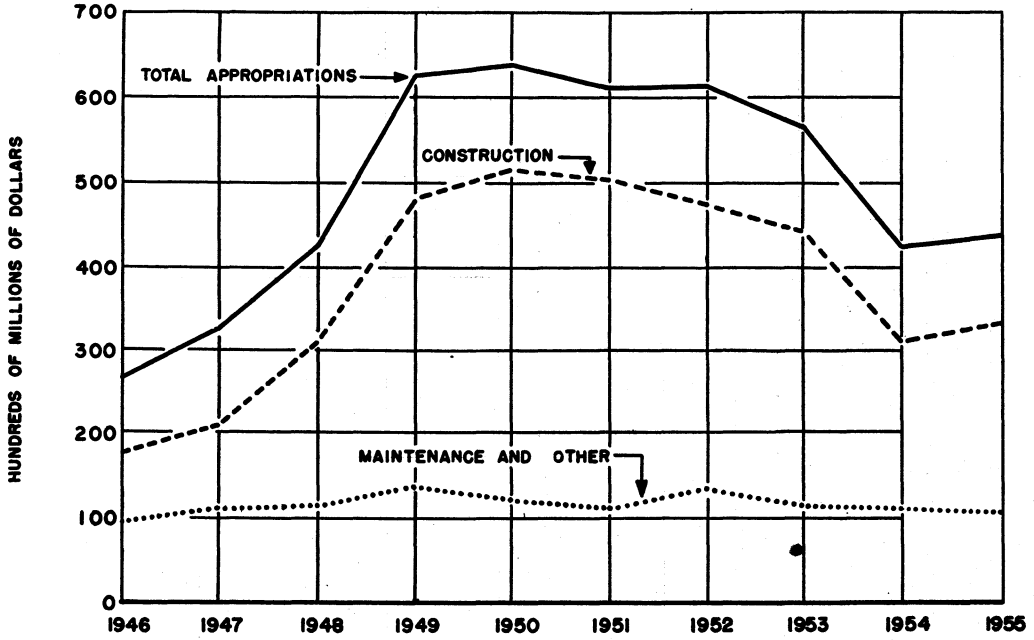
The following amounts have been advanced by local interest for river and harbor improvements under the provisions of section II, River and Harbor Act, 3 March 1925, and for flood-control works under the provisions of the Act of 15 October 1940, and are returnable to the same interests when necessary Government funds are available.

	District	Balance from U. S. 30 June 1954	Amount received during fiscal year	Amount returned during fiscal year	Balance due from U. S. 30 June 1955
Sacramento River, Calif.	Sacramento, Calif.	$200,000.00			$200,000.00
Jones Beach Inlet, N, Y.	New York N. Y.	1,357,500.00			1,357,500.00
Gulf Intracoastal Waterway, Franklin Canal, St. Marys Parish, La.	New Orleans, La.	44,000.00			44,000.00
Total, rivers and harbors		1,601,500.00			1,601,500.00
Buffalo Bayou, Tex.	Fort Worth, Tex.	2,900,000.00			2,900,000.00
Grand total		4,501,500.00			4,501,500.00

2. *Annual appropriations.* Chart V indicates the fluctuations in annual appropriations since 1946 for civil works functions and shows the downward trend since 1950, which, if continued, would increase the lag between water-resource development and the growing requirements to fulfill the expanding needs of the Nation. Chart VI shows actual appropriations adjusted to reflect rising construction costs since World War II. Although the actual appropriations for fiscal year 1955 represent a 65 percent increase over 1946, application of the Engineering News Record's cost-of-construction index to the 1955 appropriation shows a decrease of 18 percent in the amount of work which the appropriation could produce as compared to the materially

ACTUAL APPROPRIATIONS - CIVIL WORKS FUNCTIONS

FY 1946 – 1955 INCL.

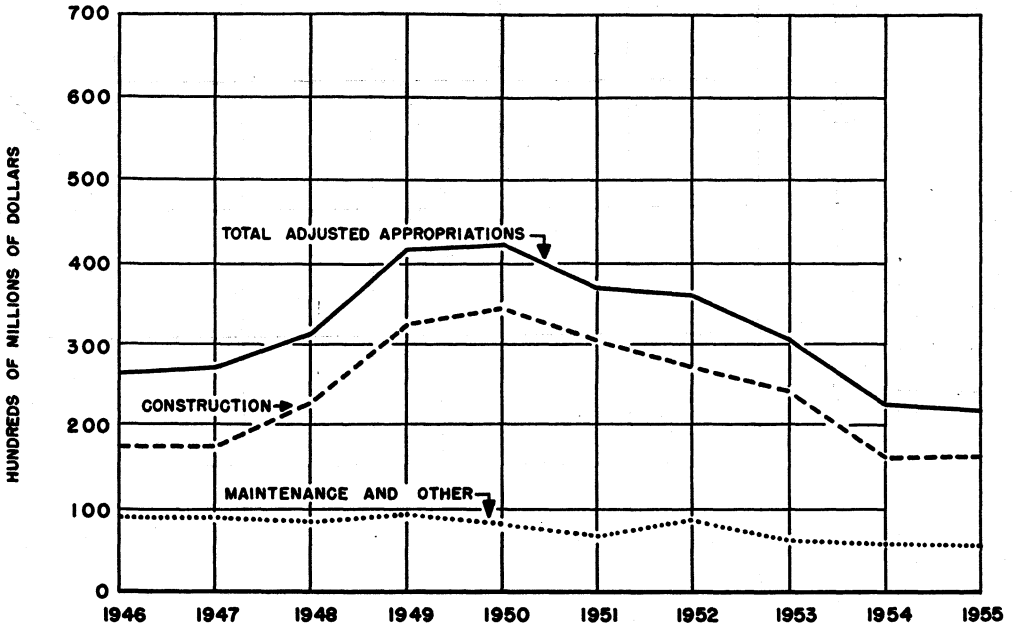


EXCLUSIVE OF APPROPRIATION TRANSFER
FOR WORK BY OTHER AGENCIES

Chart V

ADJUSTED APPROPRIATIONS-CIVIL WORKS FUNCTIONS

FY 1946 – 1955 INCL.



APPROPRIATIONS ADJUSTED TO 1946 PRICE LEVELS BY USE OF ENGINEERING NEWS RECORD CONSTRUCTION COST INDEXES

Chart VI

lower appropriation of a decade ago. This indication is offset in part by a continuing improvement in construction methods and procedures

3. *Expenditures* (*costs*). During fiscal year 1955, expenditures (costs) amounted to $502,979,000, of which $393,011,000 was for construction, general, and $109,968,000 for all other activities except those funded by contributions, advances, and collections from local sources and transfers from other agencies. Chart VII shows comparative expenditure (cost) data since 1950. Expenditures under each appropriation are listed in table 26.

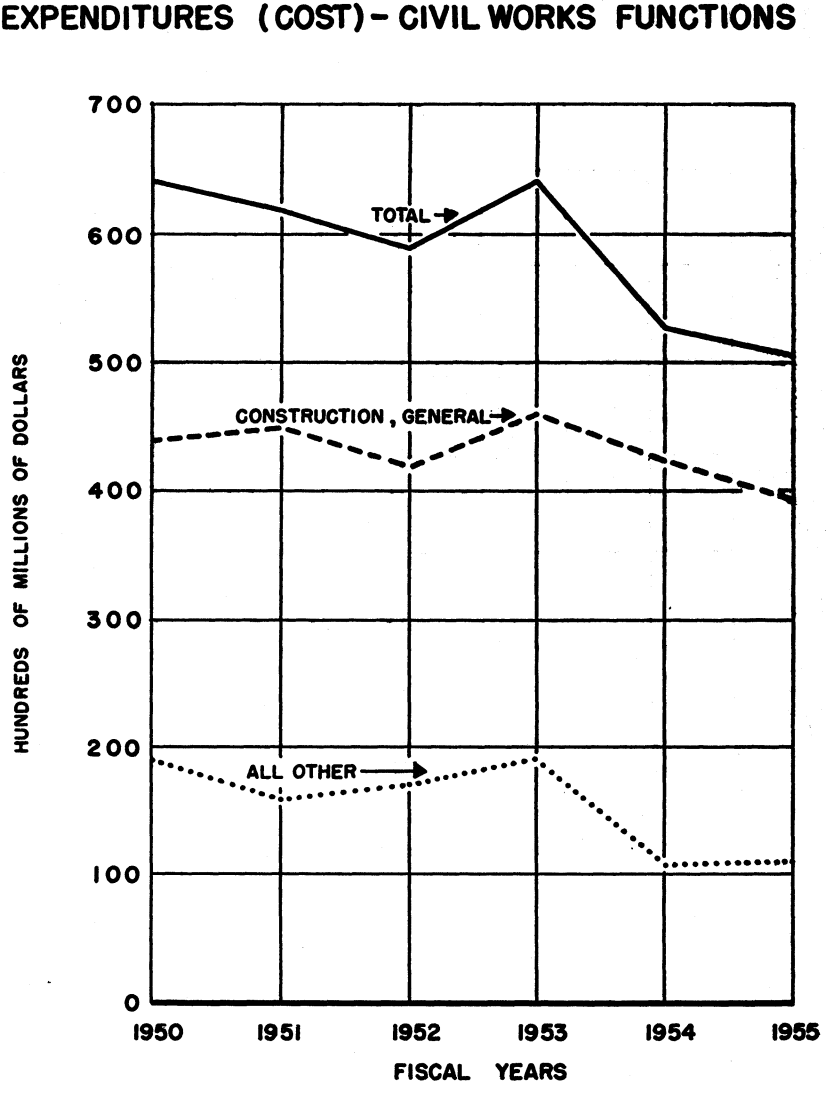


Chart VII

Table 26. Accrued Expenditures, Fiscal Year 1955

The total actually expended under the direction of the Chief of Engineers in connection with the maintenance and improvement of rivers and harbors, flood control, and other miscellaneous works during the fiscal year ended 30 June 1955 is as follows:

Appropriation title	Appropriation Act	Total
RIVERS AND HARBORS AND FLOOD CONTROL:		
Flood Control, Mississippi River and Tributaries	(1)	$45,159,514.51
General Investigations, Corps of Engineers, Civil	(1)	2,933,116.83
Construction, General, Corps of Engineers, Civil	(1)	359,752,264.06
Operation and Maintenance, General, Corps of Engineers, Civil	(1)	83,204,306.06
General Expenses, Corps of Engineers, Civil, 1944–54	(1)	23,483.24
General Expenses, Corps of Engineers, Civil, 1955	(1)	9,546,722.77
Maintenance and operation of dams and other improvements to navigable waters.	26 August 1935	152,206.26
Total, rivers and harbors and flood control		500,771,613.73
MISCELLANEOUS APPROPRIATIONS:		
Hospital and Domiciliary Facilities, Veterans Administration (allocated working fund to Corps of Engineers, Civil).	4 March 1931	914,125.05
Niagara Remedial Works, Corps of Engineers, Civil	(1)	2,207,272.77
U. S. Section, St. Lawrence River Joint Board of Engineers, Corps Engineers, Civil, 1954–55.	(1)	121,590.45
Hydraulic Mining in California, Debris Fund	19 June 1934	54,105.52
Payments to States, Flood Control Act, 28 June 1938 as amended	28 June 1938	1,053,144.41
Total miscellaneous appropriations		4,350,238.20
CONTRIBUTED AND ADVANCED FUNDS:		
River and Harbor, contributed Fund	(2)	8,063,428.45
River and Harbor, Advanced Fund	(2)	616,740.67
Total Contributed and Advanced Funds		8,680,169.12
Total Engineer Department and Contributed Funds		513,802,021.05
WORKING FUNDS (transfers from other departments):		
Working Fund, Army Engineers, Civil, no year (various projects)		792,335.82
Consolidated Working Fund, Army Engineers, Civil, 1953		−27.77
Consolidated Working Fund, Army Engineers, Civil, 1954		210,687.65
Consolidated Working Fund, Army Engineers, Civil, 1955		171,713.36
Consolidated Working Fund, Army Engineers, Civil (trust fund)		4,625.67
Consolidated Working Fund, Army Engineers, Civil (special fund), 1954–55.		53,194.34
Soldiers Home, Permanent Fund (allocated working fund to Corps of Engineers, Civil).		258,715.26
Capital Outlay, U. S. Soldiers Home (allocated working fund to Corps of Engineers, Civil).		670,093.30
Military Assistance, Near East and Africa, Executive (allocated working funds to Corps of Engineers, Civil), 1950–54.		−573,481.00
Repair of Reserve Fleet Facilities, Department of Commerce, Maritime Administration, 1955–56 (allocated working fund to Corps of Engineers, Civil).		11,085.50
Operating Expenses, Coast Guard (allocated working fund to Corps of Engineers, Civil).		391,400.00
Salaries and Expenses, Maritime Activities (allocated working funds to Corps of Engineers, Civil), 1955.		2,245.20
Total working funds		1,992,587.33
Grand total—accrued expenditures by Engineer Department		515,794,608.38

(1) Annual or supplemental.
(2) Trust funds.

CHAPTER II

PROJECT CONSTRUCTION AND OPERATIONS PROGRESS

The Civil Works program of the Corps of Engineers comprising navigation, flood control and multiple purpose projects, and various related activities, was diligently prosecuted during the fiscal year. Notable progress was made in carrying out project construction and placing additional works in useful operation. Construction was initiated on 22 new projects and on new features at 4 Mississippi River flood-control projects. Also, construction operations were carried out on 82 additional projects. Thirty-five projects including features at 9 Mississippi River flood-control projects and at 15 multiple-purpose projects were placed in effective operation. A summary of project construction and operations progress by classes follows.

1. NAVIGATION

The present program for rivers and harbors as specifically authorized by the Congress includes projects located throughout the continental United States, Puerto Rico, Alaska, and the Hawaiian Islands. These projects are of various types; deep-draft harbors accommodating oceangoing vessels, shallow-draft channels for general small-boat navigation, inland waterways for commercial barge navigation, and the Great Lakes harbors and connecting waterways.

Construction. During fiscal year 1955, major construction operations were carried out on 32 navigation projects, of which 4 were placed in useful operation as shown in table 1:

Table 1. Navigation Improvements Placed in Useful Operation During Fiscal Year 1955

Project	Date started	Date placed in useful operation	Nature of project
Black Warrior, Warrior and Tombigbee Rivers, Ala.	1949	August 1954	Construction of Demopolis lock and dam (lock only).*
Calcasieu River and Pass, La.	December 1954	April 1955	Dredging.
Humboldt Harbor and Bay, Calif.	August 1954	December 1954	Do.
Schuylkill River above Fairmount Dam, Pa.	1952	September 1954	Do.

*See table 3.

In addition to two projects shown in table 1, work was initiated on 15 navigation projects listed in table 2.

Table 2. Navigation Improvements Initiated During Fiscal Year 1955

Project	Date started	Scheduled completion date	Nature of project
Black Warrior, Warrior and Tombigbee Rivers, Ala.	October 1954	December 1957	Construction of Warrior lock and dam.
Calumet Harbor and River, Ill. and Ind.	November 1954	1960	Dredging.
Crescent City Harbor, Calif.	August 1954	1958	Breakwater.
Duluth-Superior Harbor (deepening Superior front channel), Minn.-Wis.	October 1954	October 1956	Dredging.
Grays Harbor and Chehalis River, Wash.	August 1954	December 1954	Shore revetment.
Green River channel improvement, Kentucky.	May 1955	August 1956	Channel improvement.
Gulf Intracoastal Waterway (New Orleans District), La.	February 1955	1961	Dredging and lock construction (Plaquemine-Morgan City route).
Housatonic River, Conn.	May 1955	June 1956	Dredging.
Kodiak Harbor, Alaska	March 1955	July 1956	Do.
Norfolk Harbor (Craney Island disposal area), Md.	July 1954	1960	Do.
Ohio River Ky., Ohio, and W. Va.	October 1954	1960	Construction of Greenup locks and dam.
Ohio River, Ohio and W. Va.	October 1954	1959	Construction of New Cumberland locks and dam.
Port Aransas-Corpus Christi Waterway, Tex.	November 1954	April 1956	Dredging.
Portland Harbor, Maine	April 1955	June 1957	Do.
San Joaquin River (Stockton deep water channel), Calif.	January 1955	After 1961	Do.

The 13 navigation projects having major construction activity underway at the close of the fiscal year, exclusive of 15 new starts listed in table 2, are shown in table 3. Prior to fiscal year 1954 the only activity under construction under the Arkansas River project was emergency bank stabilization, the remainder of the project being "deferred for restudy." During this fiscal year the project was removed from this category.

Maintenance. Maintenance and operation activities were conducted on 219 navigation projects during the fiscal year at a cost of $65,697,000. Every effort consistent with budgetary requirements is made to maintain the navigation projects adequately to serve the reasonable requirements of commerce and navigation. In allocating the limited amount of funds being provided for project maintenance, it is the present policy to provide for only the essential needs of commerce and navigation at deep-draft harbors and major inland waterways, and for those relatively few channels serving areas where hardship to the locality would result from nonmaintenance. The maintenance program for dredging and structure repairs is held to

the minimum, including restrictions in widths and depths of channel dredging, deferment of shallow-draft dredging, and deferment of repairs to structures on a calculated-risk concept.

Table 3. Major Navigation Improvements Under Construction 30 June 1955

Project	Started	Scheduled completion date	Nature of project
Arkansas River and tributaries, Ark.-Okla.	1950	After 1961	Bank stabilization.
Black Warrior, Warrior and Tombigbee Rivers, Ala.	1949	January 1956	Construction of Demopolis dam.[1]
Buffalo Harbor, N. Y.	1949	After 1961	Structures and dredging.
Canaveral Harbor Fla.	1950	After 1961 [2]	Construction.
Cleveland Harbor, Ohio	1950	1958	Replace bridges and dredging.
Green River, Ky.	1954	May 1956	Reconstruction of locks 1 and 2.
Gulf Intracoastal Waterway (Galveston District), Tex.	1942	After 1961	Dredging and construction.
Gulf Intracoastal Waterway (New Orleans District), La.	1942	After 1961	Construction and dredging.
Mississippi River between Missouri River and Minneapolis, Minn.	1952	June 1957	Reconstruction of lock 19.
Mississippi River between Missouri River and Minneapolis, Minn.	1948	After 1961	Construction of channel extension above St. Anthony Falls.
Missouri River, Kansas City to Mouth, Mo.	1912	After 1961	Bank stabilization.
Missouri River, Kansas City to Sioux City, Iowa.	1928	After 1961	Do.
New York and New Jersey Channels N. J.	1933	1960	Dredging.

[1] See table 1.
[2] Harbor is in useful operation. Construction of lock required to complete the project.

The program for operation, maintenance and repair of locks, dams and bridges is limited to activities necessary to meet current needs of commercial navigation. The operation of locks is curtailed or suspended whenever commercial traffic on any canalized waterway or section thereof is found to have receded to the point where continued operation cannot be justified economically.

Inactive canalized waterways. The 11 canalized waterways listed in table 4 have been declared inactive, and the project structures are no longer operated because commercial navigation has receded to the point where little or no benefit to general commercial traffic exists.

An amendment to the constitution of the State of Illinois was voted upon in the November election to provide necessary authority for the State to accept the transfer of and maintain the Illinois-Mississippi Canal properties, and a bill was passed by the Illinois legislature authorizing the State to accept. Bills were introduced in Congress for authorizing transfer of this project to the State. Other congressional bills were introduced authorizing disposal of all of the other listed projects except Upper Fox River, Wis. None of these bills were enacted.

Table 4. Canalized Waterway Projects on Which Maintenance Has Been Discontinued

Project	Structures
Big Sandy River, Ky	5 locks and dams.
Congaree River, S. C	1 lock and dam.
Green River, Ky	2 locks and dams (Nos. 5 and 6).
Illinois and Mississippi Canal, Ill	34 locks and other structures.
Little Kanawha River, W. Va	5 locks and dams.
Muskingum River, Ohio	11 locks and dams.
Osage River, Mo	1 lock and dam.
Rough River, Ky	1 lock and dam.
Upper Fox River, Wis	9 locks, 7 dams.
Upper White River, Ark	3 locks and dams.
Yamhill River, Oreg	1 lock and dam.

2. GENERAL FLOOD CONTROL

The statutory backgrounds and broad descriptions of the authorized general flood-control program and the program for the Sacramento River, Calif., were fully discussed on pages 4 through 9 of part I, volume I of the Annual Report of the Chief of Engineers for 1953. Those remarks are still pertinent.

Construction. During the year major construction operations were carried out on 56 specifically authorized flood-control projects, exclusive of multiple-purpose projects, of which 7 were completed for beneficial use as shown in table 5.

Table 5. Flood-Control Projects Placed in Useful Operation During Fiscal Year 1955

Project	Date started	Date placed in useful operation	Nature of project
Aitken, Minn	1952	February 1955	Local protection.
Covington, Ky	1948	December 1954	Do.
Fort Worth Floodway, Tex	1950	October 1954	Do.
Hutchinson, Kans	1952	June 1955	Do.
Lewisville Reservoir, Tex	1948	November 1954	Reservoir.
Natchitoches Parish, La. (Cane River-Red Bayou Unit).	1952	November 1954	Local protection.
New Albany, Ind	1948	July 1954	Do.

During the year work on five specifically authorized flood-control projects, exclusive of multiple-purpose projects, was initiated as shown in table 6.

Table 6. Flood-Control Projects Initiated During Fiscal Year 1955

Project	Date started	Scheduled completion date	Nature of project
Barbourville, Ky	June 1955	1957	Levees and walls.
Beardstown, Ill	December 1954	1959	Do.
Ferrells Bridge Reservoir, Tex	January 1955	1959	Reservoir.
Johnsonburg, Pa	November 1954.	1956	Levees, walls and channel improvement.
Toronto Reservoir, Kans	January 1955	1959	Reservoir.

The 45 major flood-control projects still under active construction at the close of fiscal year, exclusive of multiple-purpose projects and those projects initiated during the fiscal year as given in table 6, are listed in table 7.

Table 7. Major Flood-Control Projects Under Construction 30 June 1955

Project	Date started	Scheduled completion date	Nature of project
Adams, Mass	1950	1958	Local protection.
Belton Reservoir, Tex	1949	June 1957	Reservoir.
Benbrook Reservoir, Tex	1947	June 1957	Do.
Chariton River, Iowa and Wis	1948	1959	Local protection.
Cherry Valley Reservoir, Calif	1950	June 1956	Reservoir.
Coralville Reservoir, Iowa	1949	1958	Do,
Cumberland and Ridgely, Md., and W. Va	1949	1958	Local protection.
Dallas Floodway, Tex	1953	1958	Do.
Degognia and Fountain Bluff Drainage and Levee District, Ill.	1944	June 1957	Do.
Dillon Reservoir, Ohio	1946	(*)	Reservoir.
East St. Louis and Vicinity, Ill	1937	1960	Local protection.
Florida, Central and Southern Fla	1950	After 1961	Do.
Harlan County Reservoir, Nebr	1946	November 1955	Reservoir.
Isabella Reservoir, Calif	1948	June 1956	Do.
Kanopolis Reservoir, Kans	1940	November 1955	Do,
Kansas Citys, Kans., and Mo	1940	1959	Local protection.
Lavon Reservoir, Tex	1948	June 1956	Reservoir.
Lewisville Reservoir, Tex	1948	June 1957	Do.
Los Angeles County Drainage Area (exclusive of Whittier) Narrows Reservoir, Calif.	1938	After 1961	Local protection.
Louisville, Ky	1947	June 1956	Do.
Lucky Peak Reservoir, Idaho	1949	June 1956	Reservoir.
Maysville, Ky	1949	August 1956	Local protection.
Memphis, Wolf River and Nonconnah Creek, Tenn	1939	1959	Do.
Missouri River Agricultural Levees, Iowa, Kans., Mo., and Nebr.	1948	After 1961	Do.
Missouri River, Kenslers Bend to Sioux City, Iowa	1946	After 1961	Do.
Oklahoma City Floodway, Okla	1952	1958	Do.
Oologah Reservoir, Okla	1950	(*)	Reservoir.
Perry County Drainage and Levee Districts, Nos. 1, 2 and 3, Mo.	1937	1959	Local protection.
Pine Flat Reservoir, Calif	1947	June 1956	Reservoir.

*Construction of this project was inactive on 30 June 1955.

Table 7. Major Flood-Control Projects Under Construction 30 June 1955—Con.

Project	Date started	Scheduled completion date	Nature of project
Pineville, Ky	1953	December 1956	Local protection.
Red River Levees and Bank Stabilizations below Denison Dam, Ark., La., and Tex.	1948	After 1961	Do.
Red River of the North, Minn., and N. Dak	1950	After 1961	Do.
Rio Grande Floodway, N. Mex. (Albuquerque unit)	1954	August 1956	Do.
Sacramento River, Calif	1918	1960	Do.
San Angelo Reservoir and Floodway, Tex	1947	Mar 1957	Reservoir.
San Antonio Reservoir, Calif	1952	June 1956	Do.
Sutton Reservoir, W. Va	1949	1959	Do.
Texarkana Reservoir, Tex	1948	June 1957	Do.
Tuttle Creek Reservoir, Kans	1952	(*)	Do.
Vincennes, Ind	1952	1958	Local protection.
Whittier Narrows Reservoir, Calif	1950	September 1956	Reservoir.
Wichita and Valley Center, Kans	1950	1958	Local protection.
Willamette River Bank Protection, Oreg	1938	After 1961	Do.
Williamsport, Pa	1940	December 1955	Do.
Wood River Drainage and Levee District, Ill	1947	1960	Do.

*Construction of this project was inactive on 30 June 1955.

Maintenance. Maintenance and operation activities were conducted on 114 flood-control projects during the fiscal year at a cost of $4,056,700.

3. MULTIPLE-PURPOSE (POWER) PROJECTS

The importance of multiple-purpose projects in relation to the overall activities of the Corps of Engineers continued to increase during the fiscal year as a result of the large construction program relating to these projects currently underway and the completion and placing in operation of primary-purpose features at several projects. These projects have been designed to serve primarily in the interest of navigation or flood control and the production of hydroelectric power, although frequently other benefits, such as irrigation, pollution abatement, water supply, and recreation are also realized.

The inclusion of power features in conjunction with other project features has often resulted in an enhancement of their economic value. Pertinent information on the power aspects of multiple-purpose projects is contained in section 4, Hydroelectric Power Production.

Construction. During the year construction operations were carried out on 23 multiple-purpose projects, of which one was completed for full beneficial use as shown in table 8.

During the year work was not initiated on any multiple-purpose projects.

There were 22 multiple-purpose projects under active construction at the end of the fiscal year. Of these, there were 15 projects with

some or all primary project features in useful operation at the end of the year. These projects are listed in table 9.

Table 8. Multiple-Purpose Projects Completed for Full Beneficial Use During Fiscal Year 1955

Project	Date started	Date completed for beneficial use	Project primary purposes
Lookout Point Resevoir, Oreg.	1947	May 1955	Flood control,* navigation,* power and irrigation.

*These primary purposes completed for beneficial use prior to fiscal year 1955.

Table 9. Multiple-Purpose Projects Under Construction With Some or All Primary Project Features in Useful Operation 30 June 1955

Project	Date started	Scheduled completion date	Features placed in operation during fiscal year 1955	Project primary purposes
Albeni Falls Reservoir, Idaho.	1951	June 1956	Initial power units, April and May.	Flood control,* navigation,* and power.
Blakely Mt. Reservoir, Ark.	1946	June 1956		Flood control* and power.
Bull Shoals Reservoir, Ark. and Mo.	1946	December 1956		Flood control* and power*.
Cheatham Lock and Dam, Tenn.	1950	1958		Navigation* and power.
Clark Hill Reservoir, Ga. and S. C.	1946	June 1956	Final power units, July	Flood control,* navigation,* and power.*
Detroit Reservoir, Oreg.	1946	June 1956		Flood control,* navigation,* power, and irrigation*.
Folsom Reservoir, Calif.	1949	June 1956	Initial power unit May, flood control (partial), March.	Flood control, power, and irrigation.
Fort Gibson Reservoir, Okla.	1942	May 1957		Flood control,* and power.*
Fort Randall Reservoir, S. Dak.	1947	1958	Four additional power units; October (2 units), February and June flood control (fully operative).	Flood control,* navigation, and power.
Garrison Reservoir, N. Dak.	1946	1960	Flood control (partial), November.	Flood control,* navigation,* and power.
John H. Kerr Reservoir, Va. and N. C.	1946	June 1956		Flood control,* and power*.
Lookout Point Reservoir, Oreg.	1947	June 1957	Four power units December, February, April, and May.	Flood control, navigation, power,* and irrigation.
McNary Lock and Dam, Wash. and Oreg.	1947	June 1957	Four additional power units, September, December, February, and May.	Navigation,* power, and irrigation*.
Old Hickory Lock and Dam, Tenn,	1952	1958		Navigation* and power.
Tenkiller Ferry Reservoir, Okla.	1947	December 1955		Flood control* and power.*

*Projects operated for these primary purposes at the beginning of and throughout fiscal year 1955.

Of the multiple-purpose projects under active construction at the end of the fiscal year, seven projects had no primary-project features in operation. They are shown in table 10.

In connection with the Table Rock project, it is significant that the dam contract was awarded at a saving of $10 million and that the bid of an English firm was sufficiently low on the turbines that it was awarded the contract. Lengthy negotiations with the Missouri State Highway Commission culminated in an agreement to relocate existing highways.

Table 10. Multiple-purpose Projects Under Construction and Not Operating 30 June 1955

Project	Date started	Scheduled completion date	Project primary purposes
Buford Reservoir, Ga.	1950	1958	Flood control, navigation, and power.
Chief Joseph Dam, Wash.	1949	1959	Power.
Gavins Point Reservoir, Nebr. and S. Dak.	1952	1958	Flood control, navigation, and power.
Jim Woodruff Lock and Dam, Fla. and Ga.	1947	1958	Navigation and power.
Oahe Reservoir, S. Dak.	1949	After 1961	Flood control, navigation, power, and irrigation.
Table Rock Reservoir, Ark. and Mo.	1953	1960	Flood control and power.
The Dalles Lock and Dam, Wash. and Oreg.	1952	1961	Navigation and power.

Maintenance. Operation and maintenance activities were conducted on 28 multiple-purpose projects during the fiscal year at a cost of $9,919,500.

4. HYDROELECTRIC POWER PRODUCTION

Great strides continued to be made during the fiscal year in accomplishing the program of constructing and operating hydroelectric power production facilities authorized and operated in connection with navigation and flood control projects. Increased generating capacity added was exceeded by that added during only one previous year and power production was very substantially above any previous year.

At projects constructed and operated by the Corps of Engineers, 12.64 billion kilowatt-hours were generated during the fiscal year. This represents approximately 11.7 percent of the hydroelectric power produced and 2.5 percent of the total production by all sources for the Nation's utility systems.

The Corps of Engineers, with one minor exception, is not involved in the distribution and sale of the power produced at the projects, since under the various laws the power produced and available for sale is delivered to the control of the Secretary of the Interior for disposition at rates approved by the Federal Power Commission.

Installed capacity. Additional generating capacity of 643,400 kw representing 34 percent of the hydroelectric capacity or 4.3 percent of the total generating capacity added to the Nation's utility systems during the fiscal year was installed by the Corps of Engineers in three existing projects and two new projects as shown in table 11.

Table 11. Generating Capacity Placed in Service During Fiscal Year 1955

Project	Added capacity (kilowatts)
Albeni Falls, Idaho *	28, 400
Clark Hill, Ga. and S. C	40, 000
Fort Randall, S. Dak	160, 000
Lookout Point, Oreg.*	135, 000
McNary, Oreg. and Wash	280, 000
Total	643, 400

*Projects beginning initial operation during fiscal year.

This large block (table 11) of additional generating capacity contributed greatly to alleviating power shortages, particularly in the critically deficient northwest region and where 443,400 kilowatts of additional capacity from the McNary, Lookout Point and Albeni Falls projects were made available to the Northwest Power Pool during the fiscal year. Making available a relatively large block of power from the Fort Randall project will have a very favorable effect on the power supply situation in the Missouri Valley. The additional generating capacity constructed and placed in operation increased the total generating capacity in service at the end of the fiscal year at projects constructed and operated by the Corps of Engineers to 3,160,200 kilowatts located in 22 projects shown in table 12. As of the end of the fiscal year, the generating capacity operated by the Corps of Engineers represented 2.9 percent of the total generating capacity and 13 percent of the hydroelectric generating capacity supplying utility systems in the United States.

Table 12. Hydroelectric Stations in Operation 30 June 1955

Project	Initial scheduled operation fiscal year	Existing installation (kilowatts)	Uunder construction (kilowatts)	Ultimate installation (kilowatts)
Albeni Falls, Idaho	1955	28, 400	14, 200	42, 600
Allatoona, Ga	1950	74, 000	----------	110, 000
Bonneville, Oreg. and Wash	1938	518, 400	----------	518, 400
Bull Shoals, Ark. and Mo	1953	160, 000	----------	320, 000
Center Hill, Tenn	1951	135, 000	----------	135, 000
Clark Hill, Ga. and S. C	1953	280, 000	----------	280, 000
Dale Hollow, Tenn	1949	54, 000	----------	54, 000
Denison, Okla. and Tex	1945	70, 000	----------	175, 000
Detroit, Oreg	1954	118, 000	----------	118, 000
Fort Gibson, Okla	1953	45, 000	----------	67, 500
Fort Peck, Mont	1944	85, 000	----------	165, 000
Fort Randall, S. Dak	1954	240, 000	80, 000	320, 000
John H. Kerr, N. C. and Va	1953	204, 000	----------	204, 000
Lookout Point, Oreg	1955	135, 000	----------	135, 000
McNary, Oreg. and Wash	1954	560, 000	420, 000	980, 000
Narrows, Ark	1950	17, 000	----------	25, 500
Norfork, Ark. and Mo	1944	70, 000	----------	140, 000
Philpott, Va	1954	14, 000	----------	14, 000
St. Marys, Mich	1952	18, 400	----------	18, 400
Tenkiller Ferry, Okla	1954	34, 000	----------	34, 000
Whitney, Tex	1954	30, 000	----------	30, 000
Wolf Creek, Ky	1952	270, 000	----------	270, 000
Total projects in operation	----------	3, 160, 200	514, 200	4, 156, 400

Hydroelectric power production. Improved water supply conditions plus the additional generating capacity installed in existing and new projects permitted the generation of 12.64 billion kilowatt hours or an increase of 42 percent as compared to the prior fiscal year. Chart I indicates the trend in power generation at Corps of Engineers' projects.

Additional capacity under construction. At the end of the fiscal year, the Corps of Engineers had under construction additional generating capacity of 514,200 kilowatts at three operating projects as shown in table 12, and 3,053,000 kilowatts at 11 new projects or a total of 3,567,200 kilowatts currently under construction as shown by table 13.

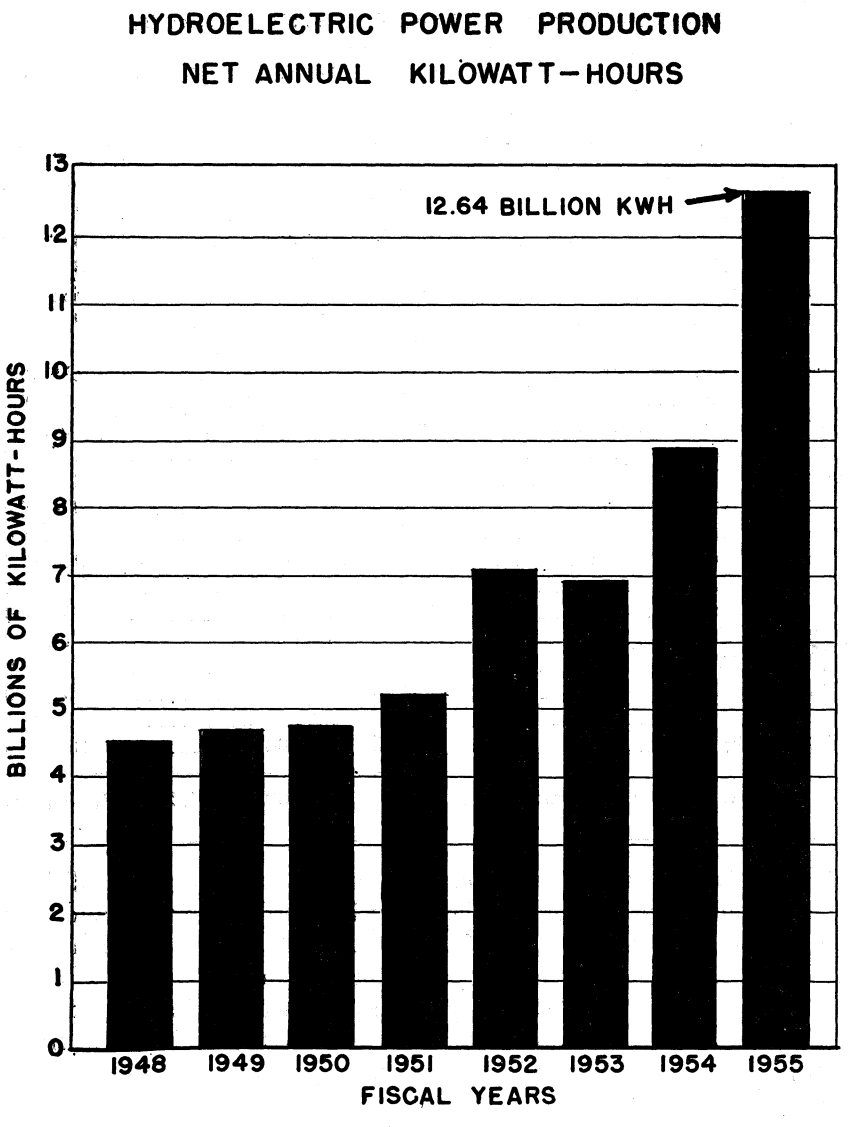


Chart I

The projects operating and under construction will have an ultimate installed capacity of 8,136,400 kilowatts, of which, under present schedules, 4,920,400 kilowatts will be available for service by 30 June 1957. Chart II indicates the rapid increase in installed capacity.

Table 13. Hydroelectric Stations Under Construction 30 June 1955

Project	Scheduled operation fiscal year	Nameplate capacity		
		Existing installation (kilowatts)	Under construction (kilowatts)	Ultimate installation (kilowatts)
Blakely Mountain, Ark	1956	----------	75, 000	75, 000
Buford, Ga	1957	----------	86, 000	86, 000
Cheatham, Tenn	1958	----------	36, 000	36, 000
Chief Joseph, Wash	1956	----------	1, 024, 000	1, 280, 000
Garrison, N. Dak	1956	----------	240, 000	400, 000
Gavins Point, Nebr. and S. Dak	1957	----------	100, 000	100, 000
Jim Woodruff, Fla	1957	----------	30, 000	30, 000
Oahe, S. Dak. and N. Dak	1962	----------	170, 000	425, 000
Old Hickory, Tenn	1957	----------	100, 000	100, 000
Table Rock, Ark. and Mo	1959	----------	100, 000	200, 000
The Dalles, Oreg. and Wash	1958	----------	1, 092, 000	1, 248, 000
Total projects under construction	--------	----------	3, 053, 000	3, 980, 000
Total projects in operation (table 12)	--------	3, 160, 200	514, 200	4, 156, 400
Total projects operating and under construction	--------	3, 160, 200	3, 567, 200	8, 136, 400

5. MISSISSIPPI RIVER FLOOD CONTROL

The project for Mississippi River and tributaries, authorized by the Flood Control Act of 15 May 1928 and subsequent amendments, provides for the protection of its alluvial valley below Cape Girardeau, Mo., from Mississippi River and local floods by means of levees and floodwalls, channel realinement and stabilization, reservoirs, floodways and outlets, and drainage works. Authorizations through 1953 are described on pages 10 and 11 of part 1, volume I of the Annual Report of the Chief of Engineers for 1953. Amendments to this project in the Flood Control Act, approved 3 September 1954, authorized construction of the following additional improvements:

Work authorized	Estimated additional cost in dollars	Document
a. Control of Old and Atchafalaya Rivers and a lock for navigation, La.	*32, 000, 000	H. Doc. 478, 83d Cong., 2d Sess.
b, Navigation channel from Mississippi River via Old and Atchafalaya Rivers to Morgan City, La.	440, 000	S. Doc. 53, 82d Cong., 1st Sess.
c. Vicksburg-Yazoo industrial area modification, Miss	----------	H. Doc. 85, 83d Cong., 1st Sess.
d, New Madrid floodway modification, Mo	1, 743, 000	H. Doc. 183, 83d Cong., 1st Sess.
e. Flood control in the Reelfoot Lake area, Tenn. and Ky.	748, 100	S. Doc. 160, 83d Cong., 2d Sess.

*Exclusive of the navigation lock and in addition to the $15,000,000 already authorized.

HYDRO-POWER PRODUCTION CAPACITY OPERATING AND SCHEDULED

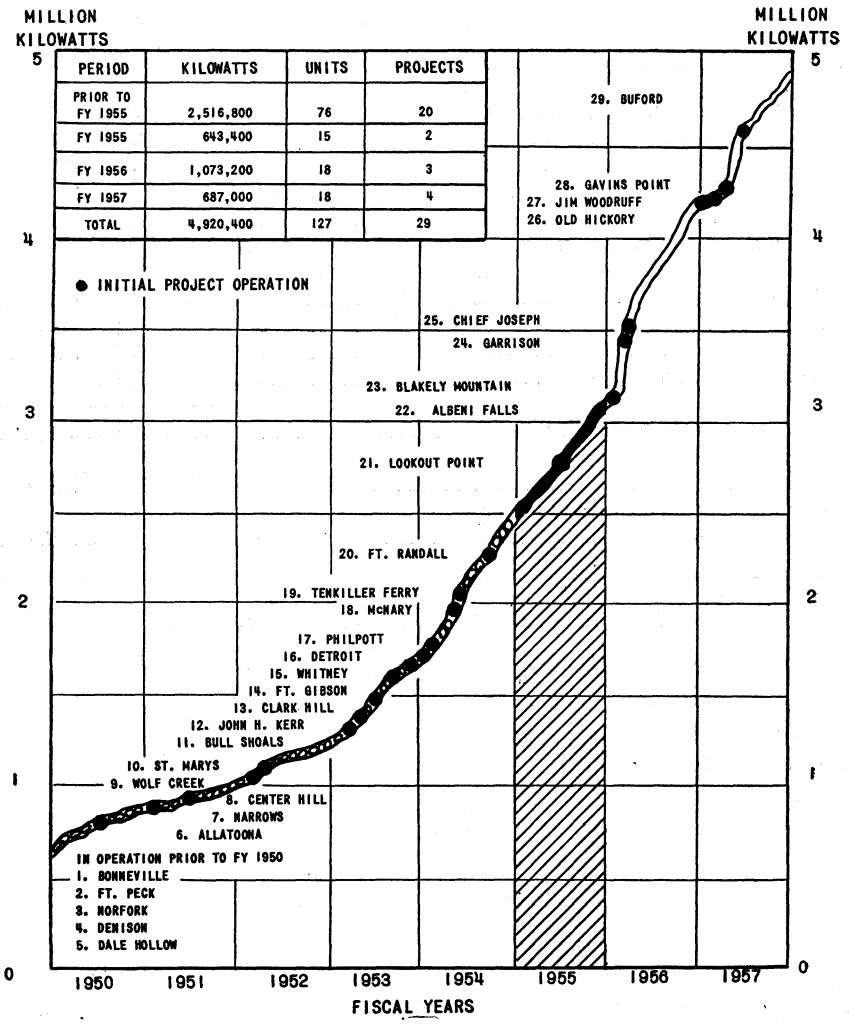


Chart II

The total authorization for the project at the end of the fiscal year is $1,327,679,600 of which $881,535,700 has been appropriated and $877,016,900 expended.

Construction. During the year the following items of construction were placed in useful operation:

Table 14. Work Placed in Useful Operation During the Fiscal Year 1955

Project	Date started	Date placed in useful operation	Nature of project work
Memphis Harbor	1953	November 1954	Nonconnah Creek, sewer.
Atchafalaya Basin, La.	1954	December 1954	Bayou Boeuf closure, phase I.
	1955	May 1955	Bayou Boeuf Lock, approach.
	1955	May 1955	Tiger Island, pumping station.
	1954	December 1954	Wax Lake East, drainage structure.
	1953	September 1954	N.O.T. and M., trestle section.
	1955	April 1955	Charenton drainage canal enlargement.
	1953	September 1954	Highway 30, surfacing.
Tensas Basin, Ark. and La.	1953	December 1954	Reach 1, Boeuf River.

In addition 74 miles of mainline levees and 30 miles of mainstem revetment were constructed.

During the year work on the following project features was initiated:

Table 15. Work Initiated During Fiscal Year 1955

Project	Date started	Scheduled completion date	Nature of project work
Atchafalaya Basin, La.	May 1955	1956	Bayou Courtableau, drainage structure.
	December 1954	1956	Bayou Courtableau, outlet channel.
Yazoo Basin, Miss.	October 1954	1957	Yazoo City, pumping station.
Tensas Basin, La. and Ark.	October 1954	1957	Enlargement of Big Bayou.

Condition of overall project. At the end of the fiscal year construction on the project as a whole between Cape Girardeau, Mo., and the Gulf of Mexico was 61 percent complete based on the addition of 1954 authorizations. Work on the mainstem has reached a point where excellent protection is afforded most of the alluvial valley from overflow by Mississippi River floods, except in exposed backwater areas. A total of 1,286 miles of mainline levees have been enlarged to project grade and section. The stabilization of the mainstem has advanced steadily by the straightening of the channel and construction of 311 miles of operative bank revetments now in place. Additional stabili-

zation work must be accomplished to insure the integrity of the river banks and the safety of the flood-control structures located thereon. The Wappapello Reservoir in the St. Francis Basin, Mo. and Ark., and the Arkabutla, Sardis, Enid, and Grenada Reservoirs in the Yazoo Basin, Miss., have been completed. Other improvements including levees, channel improvements, and supplementary drainage works are under construction in these basins and the lower White, Tensas, Atchafalaya, Courtableau, and Pontchartrain Basins. The Bonnet Carre, Morganza, West Atchafalaya, and Atchafalaya floodways will permit the diversion of over 1,750,000 cubic feet per second of extreme flood discharge, and leave 1,250,000 cubic feet per second to pass safely down the mainstem at New Orleans. The total damages that have been prevented since the adoption of the project are estimated at more than $5 billion, which amounts to approximately $5 of savings to every dollar of project funds so far appropriated.

Mississippi River bank stabilization. An outstanding example of the work performed under the Mississippi River flood-control project is the bank stabilization work. Placed primarily at localities where the river current is attacking the bank, revetment arrests bank caving and makes expensive levee setbacks unnecessary. Other revetment is placed where the river alinement is satisfactory and where caving of banks should not be permitted to start.

This feature of the flood-control project includes revetment and dikes placed between Cairo, Ill., and the end of the Mississippi River levee system below New Orleans, a distance of about 950 river miles, and along the west bank of the Ohio River below Cache River near Cairo.

The development of bank revetment for the Mississippi River has been a continuing process, with improvements being made each year in the revetment itself and in the equipment and techniques of placement. Constant efforts have been made to perfect a practical and economical means of protecting the river banks from destructive scour and erosion. Many types of subaqueous revetment have been placed, including woven willow mattress, woven lumber mattress, concrete lap slab, concrete butt slab, and others. The revetment now in use is clearly superior to earlier types used. This consists of an articulated concrete mattress placed on a graded bank by specially designed equipment.

Revetment squares, from which concrete mattresses are assembled, are 4 feet wide and 25 feet long and are composed of concrete blocks held together by corrosion-resistant reinforcing fabric. The squares are cast, using production-line techniques, at seven fields located along the Mississippi River at points selected to hold transportation to a minimum. These squares are assembled on special barges to form a continuous mattress which is sunk to conform to the river bank

and bed, extending from just above the water's edge past the deepest part of the channel. Paving of the bank above the water's edge completes the revetment. Normally, the upper bank paving is composed of riprap stone or of an uncompacted mixture of sand and asphalt.

Improvements in casting and placement techniques have kept pace with those in plant design. The result of this constant effort to place better revetment faster and cheaper has been an increase in placement rate to about 800 to 1,000 linear feet of bank per working day, an excellent safety record, and very low cost. The present total cost per square foot of revetment in place is less than 39 cents.

Prevention of diversion of Old River. One of the outstanding and most dramatic features of the Mississippi River flood-control project is concerned with Old River control, a feature designed to prevent the threatened diversion of the Mississippi River to a shorter path to the Gulf of Mexico through the Old and Atchafalaya Rivers.

The tendency of the Mississippi River to seek a new course to the Gulf of Mexico has been under observation by the Mississippi River Commission for many years and it is now evident that the diversion will occur within a relatively few years unless it is arrested. The effect of the diversion upon the area below the diversion, particularly the city of New Orleans, would be disastrous. Congress has authorized this important work and has appropriated $2,250,000 to initiate construction on the first of the structures necessary.

The entire construction program, estimated to require eight to ten years for construction, calls for two control structures (a low-sill structure primarily for the passage of inbank flow, and an overbank structure for the passage of floodflows) on the west bank of the Mississippi River about 10 miles upstream from the confluence of the Old and Mississippi Rivers, raising and strengthening Mississippi River levees in the problem area to complete the closure of the Old River gap, and a navigation lock with navigation channels connecting the Mississippi and Old Rivers. This work is estimated to cost $80,800,000.

6. NIAGARA REMEDIAL WORKS

The 1950 Niagara Water Treaty with Canada permits additional diversions of water for greatly increased power developments in the United States and Canada at the falls, and also expresses the primary obligation of the two Governments to preserve and enhance the scenic beauty of Niagara Falls and River. Pursuant to this obligation, a project was developed and approved by the two Governments for remedial works necessary to produce an unbroken crestline at the falls. The works consist of a control structure extending about 1,550 feet from the Canadian shore to a point about 1 mile above the Horseshoe Falls, and for excavations and fills on both flanks of the

Horseshoe Falls, at an estimated total cost of $13,800,000 to be divided equally between the two Governments. With appropriations made in fiscal years 1954 and 1955, totaling $3,500,000, the Corps of Engineers, as the designated construction agency for the Government of the United States, has completed its portion of the work consisting of excavation and fill on the United States side of the Horseshoe Falls and has initiated landscaping of the fill and the bank area adjacent to the completed excavation. The Ontario Hydroelectric Power Commission is performing the work in Canada, consisting of the control structure and the excavation and fill required on the Canadian flank of the Horseshoe Falls.

7. GENERAL OPERATIONS

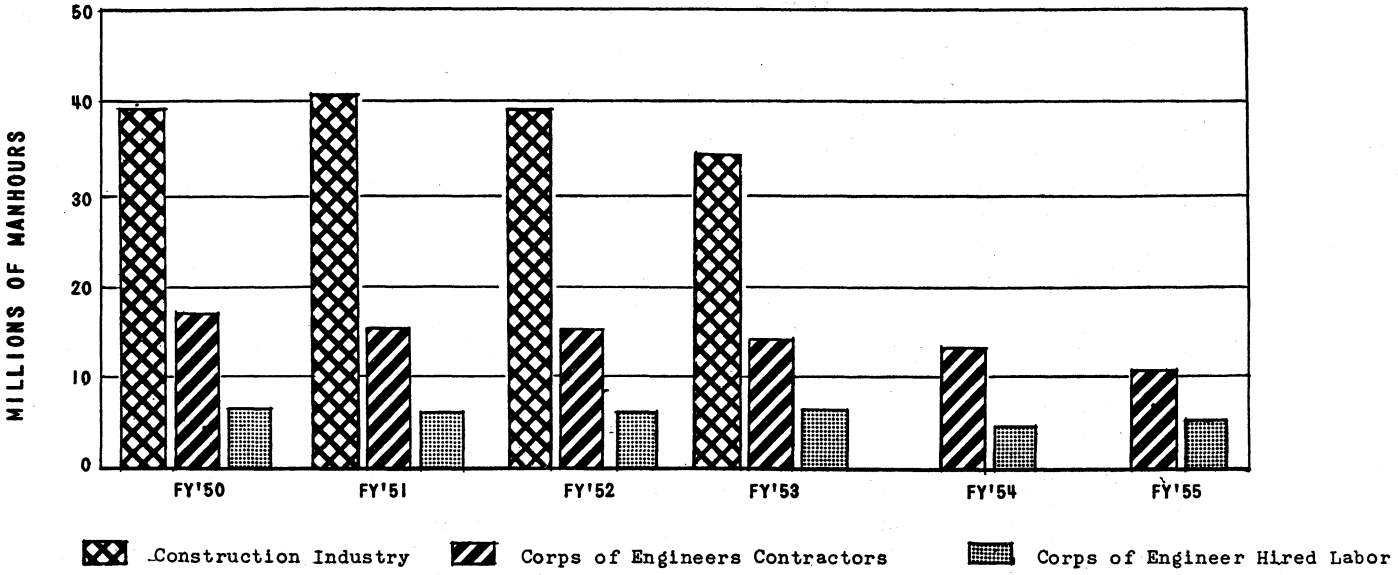
Work done by contract. The Corps of Engineers for many years has consistently adhered to its policy of having construction work done by contractors in all cases except when the best interests of the United States require hired labor operations. This past year was no exception to the policy. In fact, 94 percent of all construction work was performed by contract and only 6 percent by Government plant and hired labor. In recent years the amount of construction by hired labor has remained at this low percentage. A larger percentage of the maintenance work has been performed by hired labor. The hired labor work on construction projects has been limited to such types of operation as dredging in exposed harbor entrances by Government-owned hopper dredge, the construction of erosion control and levee revetment works, and grouting operations. The nature of such work does not readily lend itself for advertising and performance by contract.

Accident prevention. The attention which the Corps of Engineers has paid over the years to the prevention of accidents at all its construction and maintenance operations, whether by hired labor or contract, has paid sizable dividends in the improved welfare of construction workers, decreased loss of time on works, decreased costs and increased efficiency. Chart III shows the continued improvement in the disabling injury frequency rate on civil works projects for Government and contractors' employees.

Fire prevention. Corps of Engineers' property and equipment lost by fires during the year amounted to $41,000, an increase of $34,000 over the fiscal year 1954. This increase resulted almost entirely from three fires ($32,500), which were beyond the control of the Corps of Engineers. Considering the value of all plant and equipment owned by the Corps of Engineers, the fire loss is exceptionally low.

DISABLING INJURY FREQUENCY RATE

Number of Disabling Injuries Per Million Manhours Worked



NOTE: The rate for the construction industry for the years 1954 and 1955 are not available.

Chart III.

Chapter IV

CURRENT PROJECT PLANNING AND DEVELOPMENT

1. PROGRAM POLICY MATTERS

The Corps of Engineers participated extensively with other agencies in various activities pertaining to the development of National water resources policies. In addition, various policies and procedures currently in use by the Corps were reviewed, improved, and modified. The more important of these activities are discussed in the following paragraphs.

Presidential Advisory Committee on Water Resources Policy. The President established this committee to review all aspects of water policy and to make recommendations to him. The committee is composed of the Secretaries of Interior, Defense, and Agriculture with participation by the Secretaries of Commerce and Health, Education and Welfare and by the Director of the Budget on an "ad hoc" basis. During the fiscal year the Corps of Engineers furnished information and views to the committee's staff concerning basic policies affecting river basin planning, authorization of water resource projects, legal problems, sharing of costs, and many related matters; and participated in the staff discussions and preparation of material for consideration of the committee.

Commission on Organization of the Executive Branch of the Government (Hoover Commission). The Task Force on Water Resources and Power of this commission requested, and was furnished, extensive data on the flood control and rivers and harbors program of the Corps of Engineers. Representatives of the Corps also participated in discussions on water resource problems and policies with members of the Task Force. The commission's report on water resources and power was transmitted to the Congress in June 1955.

Inter-Agency Committee on Water Resources. In May 1954 the President approved an "Interagency Agreement on Coordination of Water and Related Land Resources Activities" which contemplated the establishment of the "Interagency Committee on Water Resources" to replace the Federal Interagency River Basin Committee. The Interagency Committee on Water Resources is composed of principal policy officials at the Secretarial level of the Departments of Agriculture, Army, Commerce, Health, Education and Welfare, Interior and Labor, and the Federal Power Commission. It is the responsibility of the committee to establish means and procedures to promote coordination of the water and related land resources activities of the member agencies; to undertake resolution of interagency dif-

ferences to the extent possible under existing law and administration policy; and to suggest to the President changes in existing law or administration policy which would promote coordination and eliminate or reduce interagency differences. The Committee adopted a new charter for the Missouri Basin Interagency Committee, the Columbia Basin Interagency Committee, and the Pacific Southwestern Interagency Committee, and established a permanent Arkansas-White-Red Basins field committee. A Missouri Basin program review was initiated at the request of the Bureau of the Budget.

Special interagency study on United States and Canadian storage projects, Columbia River and tributaries. The Corps of Engineers, Federal Power Commission, and various agencies of the Department of Interior cooperated in a study which provided factual information relating to the effect of various storage projects in the United States and Canada on flood control and power generation at downstream projects in the United States. The purpose of the study was to obtain basic data for use in discussions between the United States and Canadian Sections of the International Joint Commission on problems pertaining to utilization of waters of the Columbia River and tributaries which are of concern to both countries.

Partnership arrangements for power. The 84th Congress continued consideration of partnership arrangements to permit non-Federal interests to provide the power features of multiple-purpose flood control and navigation projects. New legislation to authorize partnership construction of Cougar, Green Peter, and John Day projects was proposed but was not enacted. These proposals were reviewed and comments of the Department of the Army, as requested by congressional committees, were prepared. At the end of the fiscal year, action was pending in Congress to provide funds to implement the Government's part of the Markham Ferry partnership arrangement authorized during the preceding session of Congress. Also, at the end of the fiscal year action was pending in Congress to provide construction funds for Cougar and planning funds for the Green Peter and John Day projects. It is anticipated that such funds will permit the initial phases of work on these projects to be carried forward regardless of whether or not they are eventually built as partnership ventures or entirely by the Federal Government.

The Corps of Engineers participated with non-Federal interests in the planning of the Cougar, Priest Rapids, and Markham Ferry projects with funds made available for that purpose by the preceding Congress. The Corps also considered partnership aspects of applications for licenses and preliminary permits before the Federal Power Commission and furnished its comments to the Commission.

Cost allocations. To implement the principles and procedures on cost allocations, adopted by the agreement of 12 March 1954 by the

Departments of the Army and Interior, and the Federal Power Commission, reviews were made of cost allocations for Corps of Engineers' multiple-purpose projects with power. The reviews were coordinated among field offices of the three agencies and were considered at the Washington level. Interagency staff studies were undertaken to further define allocation procedures where additional refinement of the methods adopted by the agreement appeared necessary.

Fish and wildlife. Procedures have been worked out jointly by the Corps of Engineers and the Fish and Wildlife Service for the guidance of field offices of both agencies in the formulation of general plans for management of fish and wildlife resources of reservoir projects of the Corps. These plans will be formulated jointly by the District Engineer, the head of the State wildlife agency, and the Regional Director of the Service at the earliest practicable date in the course of project construction. The plans will indicate the agency, the area, and the general purposes to be accomplished, and a license will be granted by the Secretary of the Army to the designated agency authorizing use of the area in accordance with the plan.

Watershed Protection and Flood Prevention Act, Public Law 566, 83d Congress. The Corps of Engineers worked with the Department of Agriculture and other agencies in coordination with the Bureau of the Budget in developing regulations for carrying out the provisions of the Watershed Protection and Flood Prevention Act, Public Law 566, 83d Congress. The President issued an Executive Order on 18 December 1954 placing into effect these rules and regulations. Implementing instructions outlining coordination procedures were issued to the field offices of the Corps of Engineers.

Domestic and industrial water supply. The recent drouth periods have made it apparent that water supplies are critical in many parts of the country, and that greater consideration should be given to this problem in view of increasing population and expanding industrial demands. While water supply is primarily a local responsibility, it is one of the elements of comprehensive river basin planning which is considered in connection with investigations for navigation and flood control. Provision of water supply storage in navigation and flood control reservoirs poses difficult problems of cost sharing and project evaluation, which were reviewed in considerable detail during the past year. The Senate Appropriations Committee, in its report on the Public Works Appropriation Bill, 1956, recognized this outstanding problem by stating that the Chief of Engineers should review the present authorities available to him for storage of water in Federal reservoirs to provide a water supply for municipalities, with a view to determining whether any modification of existing legislation is necessary to facilitate the development of water supply potentialities in federally constructed reservoirs.

2. AUTHORIZATION ACT OF 1954

On 3 September 1954, the President signed H. R. 9859, the River and Harbor and Flood Control Act of 1954. This legislation, the first of its kind since 1950, authorized the construction of 165 individual projects in 40 States and in Alaska and Hawaii. Additional monetary authorizations also were provided for several river basins where comprehensive basinwide plans had been approved and partial monetary authorizations provided. The increases will permit continued prosecution of these basin plans in an orderly and efficient manner. Following is a breakdown of the authorizations contained in the act:

Types of projects	Number of projects	Estimated cost
Rivers and harbors	102	$327, 200, 000
Flood control	41	297, 700, 000
Beach erosion control	22	14, 000, 000
Basin authorizations	7	413, 500, 000
Total	172	1, 052, 400, 000

3. EXAMINATIONS AND SURVEYS

The investigation program of the Corps of Engineers, which provides the basis for sound development of the Nation's water resources as administered by the Corps of Engineers, was continued to the extent consistent with funds made available by the Congress for that purpose. Accomplishment and status of the survey program are indicated in table 22.

Table 22. Summary of Reports Processed During Fiscal Year 1955 and Status at End of Year

Reports transmitted to—	Number
Congress	55
Bureau of the Budget	52
State and Federal agencies	63
River and Harbor and Beach Erosion Boards	84
Total actions	254
Status as of 30 June 1955	
Favorable reports before Congress	23
Reports in process in Office, Chief of Engineers	128
Active reports in field offices	106
Special studies active in field offices	2
Inactive reports in field offices	755
Special studies inactive in field offices	0
Total	1, 014

The Public Works Committees of Congress adopted during the year 67 resolutions requesting review of previous reports on proposed river and harbor and flood control improvements. The River and Harbor and Flood Control Act of 1954 contains authorizations for preliminary examinations and surveys of 16 localities in 12 States. These authorities are included in the above tabulation.

Current survey program. Work on only a relatively few studies was possible during the year in view of the continuing limited level of funds available for that purpose. Studies of improvements in procedures and techniques were continued, and further instructions and clarifications issued, to obtain more economical production of survey reports and to expedite review and processing. A salient feature of the improved procedure is the preparation of relatively brief and inexpensive letter reports on a number of investigations, in which it has been conclusively determined that improvement by the United States was not advisable or economically justified under existing conditions. Inter-agency coordination continued. Several special studies were essentially completed. Noteworthy features of certain special studies and other elements in the survey program are discussed below.

New England-New York Inter-Agency Committee. A provision in the Flood Control Act of 1950 authorized a comprehensive investigation of all water and land resource developments in the New England States. An inter-agency committee was formed, in accordance with the desires of the President, to survey the water and land resources of the New England-New York region. Membership consisted of one representative each of the Departments of Agriculture, Army, Commerce, Interior, Labor, and Health, Education and Welfare, and the Federal Power Commission, with the Department of the Army the Chairman agency. The survey has been conducted in cooperation with the Governors of the seven States participating in the survey. The committee completed its survey of the New England-New York region and forwarded its report to the Secretary of the Army on 15 March 1955. Subsequently, the Secretary of the Army requested the comments of the various Federal and State agencies. These comments will accompany the report when it is transmitted to the President and to the Congress. The report is a comprehensive inventory of water and land resources and indicates the economic justification of development thereof.

Arkansas-White-Red Basins Inter-Agency Committee. Congress, in the Flood Control Act of 1950, authorized a comprehensive investigation of all streams in the Arkansas, White, and Red River Basins. In accordance with the desires of the President, an inter-agency committee was organized in order that all agencies, both Federal and State, concerned with water-resources development could participate. The Department of the Army is the Chairman agency. The report has

been completed and transmitted to the Governors of the interested States and the heads of Federal agencies for their comments. These comments will accompany the report when it is transmitted to the President and the Congress. The report constitutes a general guide to the future development of the resources of the area. No detailed recommendations for authorizations and appropriations are included. It is anticipated that in the years ahead individual Federal and State agencies, and others, will develop more detailed plans for individual elements of the overall plan, and, after coordination with all interested parties, will take such steps as are necessary to proceed with their effectuation.

Survey of the San Francisco Bay area. A comprehensive preliminary examination and survey of the San Francisco Bay area was authorized by the Flood Control Act of 1950. The preliminary examination has been completed and a survey initiated by the reporting officers. Close coordination is being maintained with the State of California which has studies underway on water supply for the San Francisco Bay area. The survey will include consideration of dikes or barriers across the northern and southern halves of the Bay for fresh water impoundment and also as causeways or bridges. The study will include consideration of navigation requirements, flood control, reclamation of marginal lands, water supply in deficient areas, salt water intrusion, sediment deposition, and other water problems in the bay area. A model of the bay is being constructed to study the hydraulic features of the problem that cannot be resolved analytically.

Comprehensive review of Mississippi River and Tributaries project. A resolution by the Committee on Public Works of the United States Senate, adopted 12 June 1954, authorized a comprehensive review of the entire project. This review will cover the need for navigation improvements on the mainstem, the adequacy and cost of flood control features of the project, and the coordination of these features with the plans of other Federal and State agencies for the development and conservation of water resources and uses in the alluvial valley below Cape Girardeau, Mo. Work on this review was initiated during the fiscal year. The scheduled completion date for this review report is 30 June 1958.

Great Lakes water levels survey. A comprehensive survey is being made of the feasibility of regulating the levels of the Great Lakes to reduce damages from cyclic high-lake levels and to improve navigation use and hydroelectric power production. This study, authorized by resolution adopted 26 June 1952, by the Committee on Public Works, House of Representatives, is being made in close cooperation with the affected States. Inasmuch as the Great Lakes are international, it is necessary also to coordinate the study with Canada. Important hydrologic and hydrographic studies made in the development of a

plan of operation for the very complex regulation of the Great Lakes have provided valuable information on the problems relating to forecasting of lake levels. The work on the phase of the study pertaining to local flood protection benefits has been held in abeyance pending action by Congress clarifying Federal policy on flood problems resulting from fluctuations in lake levels.

Hurricane study. The hurricanes of recent years, particularly those of 1938, 1944, and 1954, have caused extensive and unprecedented damage to property and large loss of life along the Atlantic Seaboard. Those of 1954, particularly, resulted in shore and other property damage estimated at over $300,000,000 in New England alone, with additional damages southward to the Carolinas. In view of these disasters, Congress enacted Public Law 71, 84th Congress, approved 15 June 1955, to provide for a survey of hurricane characteristics, forecasting, and warning services, and economic measures of protection on the eastern and southern seaboards of the United States. This hurricane study is being made in cooperation with the Weather Bureau and other Federal and State agencies.

4. BOARD OF ENGINEERS FOR RIVERS AND HARBORS

The Board of Engineers for Rivers and Harbors completed during the fiscal year its review of reports made in response to 60 congressional authorizations for studies pertaining to proposed navigation and flood control improvements. It held five meetings of from 1 to 3 days' duration, conducted public hearings, and made two field inspections. The Board conducted in open session all deliberations and discussion in order that interested parties could be fully informed on the basis of the Board's decisions. The Board considered 65 preliminary examination and survey reports on proposed projects. Twenty-two of these reports contained estimated cost of construction totaling $768 million. In addition, the Board reviewed 19 reports on water resources development prepared by other Federal agencies, and prepared a number of reports on general subjects such as policies and procedures and waterways economics.

5. BEACH EROSION BOARD

The Beach Erosion Board has three basic statutory missions: (1) To cooperate with various State agencies and municipalities in making beach erosion control studies; (2) to review and comment on the beach erosion aspects of proposed navigation improvement works; and (3) to make research investigations leading to more effective and more economical practices in the control of beach erosion. The status of work on these three missions is given below. The Board completed action on four cooperative beach erosion control studies during the fiscal year and assisted State and municipal agencies in setting up the

study programs for eight new cooperative studies as indicated in table 23.

Table 23. Listing of Beach Erosion Control Cooperative Studies Completed and Applications Approved

Cooperative Studies Completed During Year
Hamlin Beach State Park, Lake Ontario, N. Y.
Braddock Bay State Park, Lake Ontario, N. Y.
City of Kenosha, Wis.
Manitowoc County, Wis.
Applications for New Cooperative Studies Approved During Year
Berrien County, Mich.
Chatham, Mass.
New Jersey Coast—Barnegat Inlet to Cape May.
Palm Beach County, Fla.
Saco Bay, Maine.
Suffolk County, Long Island, N. Y.
State of California—Application IV (San Diego County), Phase 2.
State of California—Application VI (Humboldt Bay).

Consultant advice was provided to local agencies on numerous occasions. During the year six navigation reports were reviewed for their potential effect on the adjacent shorelines.

The "research and development" mission of the Board as effected in 1945 under Public Law 166, 79th Congress, is programmed to enable the Board to determine ways to design more effective and more economical solutions to shore erosion control problems. The specific investigations undertaken in the development program have not been planned to solve a particular problem applicable only to a very limited area; rather, the investigations have been aimed to furnish design information applicable to a reasonably wide range of shoreline conditions. Prior to 1945, there was very little monetary effort being expended in the United States or abroad to provide a sounder basis for the solution of shore erosion problems. Furthermore, around the globe there was no coordination to the piecemeal efforts being made. The present research and development program began in the spring of 1946, and the Board has now engaged and trained a competent research staff and equipped itself with five experimental wave tanks of versatile design. The results of the Board's research investigations are made available to the using public in the form of publications. During the fiscal year 26 technical memoranda and 1 technical report were issued. A few of the continuing general investigations conducted during the fiscal year, on which phases have been completed, that have resulted in a more economical design of shore protection struc-

tures and in the reduction of direct damages to shoreline developments are described below.

Study of expected life of steel sheetpiling in coastal waters. This study covered the entire Atlantic Seaboard and part of the Gulf of Mexico. It enabled the Board to prepare a table of expected life of steel sheetpiling for various degrees of exposure to salt water and wave action. No reliable data were previously available on this subject. This study has pointed the way to the use of more suitable materials for coastal construction, particularly in the warmer coastal waters of the South.

Laboratory study of factors affecting beach profiles. The subject is of considerable importance to shore communities because the readjustment of a beach under the attack of storm waves frequently determines whether or not the buildings and roads on the shore will be undermined. A few years ago the literature on this subject was confused and contradictory. The study by the Board demonstrated clearly what type of wave could be expected to tear down the beach, and what type could be expected to rebuild the beach. It also demonstrated the effect of the size of sand grains composing the beach on the stability of the beach under wave attack.

Comprehensive report on shore protection techniques. Prior to 1954 the data available for the design of coastal engineering works were scattered through many publications and much of it was uncoordinated and not in a form for ready use by the practicing engineer. This situation has been remedied to a large degree by the preparation of a comprehensive report entitled "Shore Protection Planning and Design," which coordinates and makes available in one publication the best present design practice. This report is considered to be a major contribution to the field of shore protection, and has resulted in the design of more effective and economical shore protection measures.

Sand bypassing at coastal inlets. The construction of navigation improvement works at coastal inlets and coastal harbors frequently upsets the alongshore movement of sand in the area, resulting in shore accretion to one side of the structure or inlet and severe erosion on the other side. A rather obvious solution to the problem is to transport the material from the accreting side to the eroding side. However, this presents many design problems that have not yet been solved. The Board has studied all existing operations, and the lessons learned from these studies are being applied to projects of this nature which are planned for Fire Island Inlet on the south shore of Long Island and for Lake Worth Inlet at Palm Beach, Florida.

Artificial nourishment of beaches by placement of sand fill. The Beach Erosion Board has determined through field studies that many shore areas subject to erosion can be more effectively and economically protected by pumping or placing a supply of suitable sand onto the

beach. Prior to the Board's research in this field, it was the general practice to provide shore protection by the sole use of protective type structures (groins, bulkheads and seawalls). Many of these structures were ineffective and, in fact, some produced detrimental erosion effects on the downdrift shore line. The sandfill method frequently has the additional desirable benefit of providing a much needed recreational beach.

6. ADVANCE ENGINEERING AND DESIGN

During the preliminary phase of preparing authorized projects for construction, features thereof are developed, firm estimates of costs are prepared, orderly construction schedules are worked out and necessary detailed information is readied for coordination with local interests, States, and other agencies. A backlog of projects ready for initiation of construction is in preparation to allow an expansion of the civil works construction program at such time as the national budgetary policy permits, at the same time assuring the development of a sound and well-balanced program consistent with the Nation's needs in the fields of navigation, flood control, and allied water uses.

The sum of $2,603,000 was made available in fiscal year 1955 for advance engineering and design. With these funds and funds carried over from prior years, the Corps of Engineers prosecuted planning on 57 projects, consisting of 9 navigation, 40 flood control, and 8 multiple-purpose projects. Planning on 20 of these projects was advanced to the stage where construction could be readily initiated. Funds in the amount of $2,703,000, representing approximately 89 percent of the total available for this activity, were obligated during the fiscal year. In addition, $600,000 was made available by Supplemental Appropriation Act of 1955, for partnership studies on three projects: Markham Ferry Dam, Okla.; Cougar Dam, Oreg.; and Priest Rapids Dam, Wash. Partnership studies were prosecuted on each of these projects during the fiscal year with the funds appropriated.

In addition to planning work on projects, the Corps of Engineers continued its program of investigating the means of improving design and construction procedures. The accomplishments and economies effected in this field of activity are set forth in the discussion of the Civil Works investigations program in chapter VII.

7. COLLECTION AND STUDY OF BASIC DATA

The collection and study of basic data are indispensable to the planning, design and operation of the Corps' river-basin projects for the development of the Nation's water resources. This item includes those cooperative activities performed by other Federal agencies for which funds are provided by the Corps of Engineers for the basic programs of observing, compiling, reporting and publishing data on

streamflow, rainfall and fish and wildlife resources. A description of these activities during the fiscal year is presented below:

a. Cooperative programs with the United States Weather Bureau.

(1) Operation of a network of rain gages, primarily of the continuous recorder type, known as the hydroclimatic network, was continued by the Weather Bureau at the request of the Corps of Engineers. Funds in the amount of $301,330 were transferred to the Weather Bureau for operation of the network during fiscal year 1955. A total of 2,879 stations (2,347 recording and 532 nonrecording), were in operation in the network on 30 June 1955. Data from these stations are published monthly by the United States Weather Bureau in "Hourly Precipitation Data."

(2) The hydrometeorological section of the Weather Bureau was continued during the fiscal year at the request of the Corps of Engineers to review the meteorological aspects of the storm study program and to develop theoretical concepts and practical techniques for use in engineering design. Funds in the amount of $95,000 were made available to the Weather Bureau to finance the Section during fiscal year 1955. The primary accomplishments during the year were completion of an interim report on the meteorological aspects of the Lower Mississippi River project flood study; essential completion of reports on the seasonal variations of maximum possible precipitation and seasonal variations of the standard project storm rainfall; preliminary estimates of probable maximum possible precipitation of Virgin River, Nev., Kentucky River, Ky., Upper Wabash River, Ill. and Ind., Queens Creek, Ariz., Buck Creek, Ohio; review of several storm studies and other studies involving meteorological phases of engineering problems.

(3) The river and rainfall reporting networks currently totaling 42 in number, were also continued at the request of the Corps in order that frequent reports of river and rainfall data would be available as required by the District Engineers for flood control operation and flood-forecasting purposes. Funds in the amount of $79,074 were transferred to the Weather Bureau for this program during fiscal year 1955.

b. Stream gaging program of the Geological Survey. The Geological Survey was requested to continue the cooperative program of constructing, maintaining and operating stream gaging stations required in connection with Corps of Engineers' activities. A total of $859,286 was transferred to the Geological Survey for the operation of approximately 1,900 stations under this program during fiscal year 1955.

c. Cooperative program with the United States Fish and Wildlife Service.

CHAPTER VI

OTHER CIVIL WORKS ACTIVITIES

1. SAINT LAWRENCE SEAWAY

By letter dated 17 September 1954, addressed to the Secretary of the Army, the Saint Lawrence Seaway Development Corporation designated the Corps of Engineers as its agent for design and construction of the Seaway project. The corporation was created on 13 May 1954 under authority of Public Law 358, 83d Congress, 2d Session.

The project involves construction of navigation facilities in United States waters in the reach of the Saint Lawrence River which constitutes the boundary between the United States and Canada, and coordination thereof with the power facilities to be constructed concurrently by others.

With funds made available by the corporation to the Corps of Engineers preparation of plans and specifications have been initiated and contracts have been awarded for the excavation of the Long Sault Canal and the Robinson Bay Lock and Grass River Lock structures.

2. ST. LAWRENCE RIVER JOINT BOARD OF ENGINEERS

This Board, having United States and Canadian sections, was created pursuant to the order of approval issued by the International Joint Commission on 29 October 1952. The United States section was established by Executive order issued 4 November 1953. Members of the United States section are the Secretary of the Army and the Chairman of the Federal Power Commission, with the Deputy Chief of Engineers for Construction and the Chief of the Commission's Bureau of Power as alternates.

The duties of the Board are to review and approve the plans, specifications, and work schedules for the power development in the International Rapids section, St. Lawrence River, of the Power Authority of the State of New York and the Hydroelectric Power Commission of Ontario, the joint builders, filed for clearance in behalf of both Federal Governments, and to inspect construction operations to insure conformance of board approvals. A small engineering staff to support the United States group has been established in Massena, N. Y., with Washington liaison. Supervision of construction pursuant to the Federal Power Commission license issued 15 July 1953 to the

power authority has also been assigned to the United States section, thus integrating these two Federal supervisory activities.

Costs of the United States section through 30 June 1955 totaled about $121,000. An additional $150,000 has been appropriated to finance the activities of the United States section during fiscal year 1956. All costs of the United States section are subject to reimbursement by the Power Authority of the State of New York as provided in the appropriation acts.

3. FLOOD FIGHTING AND OTHER EMERGENCY OPERATIONS

The Corps of Engineers during the year participated in and supplemented the efforts of local interests in flood-fighting operations in various areas and at many localities throughout the country. These flood-emergency activities, involving advance preparation for flood emergencies, flood rescue work, flood-fighting, and the repair and restoration of flood-control works damaged or destroyed by flood, are carried on under the Corps' statutory authority set forth in Public Law 99, 84th Congress and prior legislation. In addition, disaster assistance and engineering services were made available through the Federal Civil Defense Administration, in accordance with the procedures established pursuant to Public Law 875, 81st Congress. The most noteworthy emergency operations during the fiscal year are described in the following paragraphs.

Flash Flood of 19 July 1954, West Virginia. Heavy storm rainfall caused disastrous flash flooding, affecting portions of six counties with heavy damage at Richwood, in Nicholas County, and lesser damage at Fenwich and Burnsville. Technical assistance was made available by the Corps to local interests, and between 23 and 25 July two timber trestle bridges for vehicular traffic were built in the emergency by the Corps' bridge-testing unit as replacements for washed-out bridges. Nicholas County was declared a disaster area by the President on 4 August 1954.

Flood of 6–8 October 1954, Vicinity of Roswell, N. Mex. Major flood damage occurred along the main stem of the Pecos River between Boswell and Lake McMillan, and along the principal tributaries entering this reach. Severe damages were suffered by the cities of Roswell and Artesia. Flood-fighting assistance was furnished local interests by the Corps, including emergency repair work in the vicinity of Roswell during the flood. The flooded areas were made eligible for disaster assistance by Presidential declaration of 13 October 1954.

Flood of October 1954, Illinois and Indiana. Intense precipitation in the Chicago metropolitan area of Illinois and nearby Indiana caused widespread flood damage. The President declared the affected area of Indiana a disaster area on 26 October 1954. Emer-

gency activities of the Corps included rescue work, flood-fighting assistance, and repair and restoration of flood-control works.

Hurricanes of August and October 1954. Three major hurricanes, respectively designated as Carol, Edna, and Hazel, caused disastrous damage over a wide area of the eastern United States. In addition to destructive winds, and torrential rains which caused heavy flood damages in inland areas, high tidal waters accompanying the hurricanes battered the coasts of the Carolinas and the Northeastern States. Hurricane-damaged areas of North and South Carolina, Maryland, Pennsylvania, New York, Connecticut, Rhode Island, Massachusetts, and Maine were declared by the President to be major disaster areas. The emergency activities of the Corps included maintenance of liaison with local, State, and other Federal agencies concerned; providing engineering services; collecting basic data and making damage studies and surveys for use in disaster relief and rehabilitation, and work under the Corps' statutory authorities for emergency flood-control activities and for emergency dredging and removal of obstructions in the interest of navigation.

Floods of May 1955, State of Colorado. Heavy rainfall in the Arkansas River Basin during 18–19 May caused serious flooding in a number of locations. Clark County, Colo., in which is located the city of Trinidad, where extensive damage occurred, was declared by the President on 21 June 1955 to be a disaster area. La Junta also suffered heavy damage. Emergency activities undertaken by the Corps included repair of flood-control works at La Junta and at the request of the Federal Civil Defense Administration, extensive restoration of river-bank protection at Trinidad, under Public Law 875, in order to supplement emergency bank-protection work undertaken to protect public facilities pursuant to section 14 of the Flood Control Act approved 24 July 1946.

4. ADMINISTRATION OF LAWS FOR PROTECTION OF NAVIGABLE WATERS

In administering the Federal laws enacted for the protection and preservation of the navigable waters of the United States, 6,066 permits for structures or operations in navigable waters were issued and plans for 248 bridges, dams, dikes, or causeways were approved during the year. In addition, 32 extensions of time for commencement or completion of construction of bridges were granted. Fifty-two sets of regulations for the use, administration, and navigation of navigable waters were established, including drawbridge regulations, establishment of anchorage grounds, special anchorage areas, danger zones, dumping grounds, and restricted areas.

The Corps of Engineers engaged in the following additional activities relative to the administration of the laws for protection of navigable

waters: Investigations of the discharge or deposit of refuse matter of any kind in navigable waters; prevention of pollution of coastal navigable waters by oil; administrative determination of the heads of navigation and the extent to which the laws shall apply to specific streams; supervision of the harbor of New York to prevent obstruction or injurious deposits in the waters thereof, including the waters of Long Island Sound; establishment of reasonable rates of toll for transit across bridges over navigable waters; granting of permits for the occupation and use of Federal works under control of the Corps of Engineers; reports of international boards on operations affecting international boundary waters; and legislation in connection with the foregoing.

There is a continuing program to prevent deposits or to obtain the removal of any deposits in channels which obstruct navigation or increase Federal maintenance costs. In 9 areas of the country, 24 industries, and 5 municipalities are removing, have been requested to remove, or are participating in the removal of shoals for which they are responsible. Negotiations are underway on 7 waterways with 16 companies for remedial action in connection with waste deposits causing shoaling, and negotiations are planned with 3 additional companies. During the past 5 years agreements totaling more than $3,500,000 have been reached with some of our major industries. The program has resulted not only in a saving in dredging costs and more efficient use of dredging equipment, but also in a stimulation of planning by the industries to improve their operations for recovering salvageable material. In the case of one company, which declined to accept responsibility for its deposits in the Calumet River, Ill., court action was instituted during the year and is continuing. This was the only case in which an equitable agreement could not be reached.

A report entitled "Navigational Clearance Requirements for Highway and Railroad Bridges" prepared by the United States Department of Commerce was released toward the end of this fiscal year. The conflicting interests involved are the desire of navigation interests for the maximum navigation opening and the desire of bridge owners to conserve funds by building a minimum crossing. In connection with its continuing studies of this subject, the Corps of Engineers is making a thorough review of its policy on bridge clearances with a view to resolving the problems involved in meeting the requirements of both the water and land transportation interests. The present system of standard bridge clearances is being reviewed and extended to cover, insofar as practicable and necessary, all navigable waterways. During the year a new procedure was initiated whereby a "finding of fact" is prepared for attachment to the formal approval of bridge plans. When necessary or in controversial cases, an economic analysis to determine the clearance requirements for a bridge may be developed.

One such analysis was prepared during the past year at the request of the Department of Commerce.

Under the Bridge Alteration Act (Truman-Hobbs) approved on 21 June 1940, as amended by the act of 16 July 1952, the cost of altering a bridge used for railroad traffic, combined railroad and highway traffic or a publicly owned highway bridge, found by the Secretary of the Army to be obstructive to navigation, is apportioned between the bridge owner and the United States. Hearings in connection with obstructive qualities were held on two bridges and an order to alter was served on two bridge owners. An agreement to relocate was entered into with one bridge owner. Action was continued on 10 additional obstructive bridge cases in various stages of development.

The removal of wrecks in navigable waters of the United States is governed by sections 19 and 20 of the River and Harbor Act approved 3 March 1899, and is predicated entirely upon their being obstructions to navigation. During the fiscal year, 50 wrecks were removed by the Corps of Engineers as obstructions to navigation.

5. REGULATION OF HYDRAULIC MINING, CALIFORNIA

The California Debris Commission, created by act of Congress, regulates hydraulic mining in the drainage area of the Sacramento and San Joaquin Rivers to prevent the resulting debris from being carried into navigable waters. The Commission has licensed 21 mining operators, of which 4 utilize storage behind the Federal debris dams.

During the year the Harry L. Engelbright Dam and the North Fork Dam, together with their appurtenant service facilities, were operated and maintained for the storage of hydraulic mining debris. On the Yuba River, repair of the Daguerre Point Dam, a debris barrier, and clearing, snagging, and bank-protection work were accomplished. The cost of this activity is paid in part from funds provided from receipts of contributed funds.

6. UNITED STATES LAKE SURVEY

The United States lake survey prosecuted its continuing program of preparation and revision of charts for navigation of the Great Lakes, the New York State canal system, Lake Champlain, and the Minnesota-Ontario border lakes. Work progressed during the fiscal year 1955 on the basis of a 15-year program, insofar as practicable, comprising, in addition to chart preparation and sale, hydrographic surveys, engineering studies and flow measurements, and the Great Lakes Pilot publication.

Sweeping operations in Thunder Bay Island Shoal in Lake Huron were completed during the first few weeks of the fiscal year. Preliminary testing of an electronic device "Shoran" for positioning of

survey vessels was completed. A special investigation and sounding project was accomplished in the lower end of Whitefish Bay on Lake Superior adjacent to the area surveyed in 1954. The offshore program was continued on Lake Michigan and the western half of the lake was covered from Kenosha to Port Washington and the eastern half from South Haven to Point Betsie. Inshore sounding operations were conducted in the upper portion of the International Rapids section of the St. Lawrence River during the last half of the 1954 field season. A complete inshore and revisory survey of the greater Chicago waterfront, from Gary, Ind., to Wilmette, Ill., was started in the vicinity of Chicago Harbor. Revisory surveys were made for revision of navigation charts for positions of prominent landmarks, addition of new features, and for United States harbors on the lakes and the St. Marys River. In addition to the above field operations, hydraulic and hydrology activities were carried on.

7. WASHINGTON, D. C., WATER SUPPLY

With funds appropriated for the District of Columbia water supply system, the Corps of Engineers continued the operation, maintenance, repair, and protection of the water-supply facilities, known as the Washington Aqueduct, to provide an uninterrupted and adequate supply of purified water to the distribution systems of the District of Columbia and adjacent Maryland and Virginia areas as authorized by law. The maximum daily consumption provided by the existing facilities was about 257 million gallons, and the average daily consumption was about 164 million gallons.

In order to meet the increasing demand for water, construction work continued on the long-range program. Work was completed on the first section of about 2 miles of the 48-inch transmission main from Dalecarlia to Reno Reservoir. Construction was commenced on the second section, 1,700 feet in length. Construction work was also initiated on the Dalecarlia purified-water pumping station having an installed capacity of 477 million gallons daily and the Little Falls raw-water pumping station with an installed capacity of 450 million gallons daily. The Dalecarlia pumping station is scheduled for completion in March 1957 and the Little Falls pumping station in January 1958.

Plans and specifications were essentially completed for the new Third High Reservoir at Reno. Preparation of plans and specifications was continued on a new chemical building and operating center at the McMillan filtration plant.

8. WORK FOR OTHER AGENCIES

Major dredging operations were carried out during the year for the United States Maritime Administration, with funds transferred from

that agency, at the reserve fleet site at Astoria, Oreg., and maintenance dredging was performed at the reserve fleet site at Suisun Bay, Calif. Construction of cathodic protection systems for vessels was initiated or performed at the reserve fleet sites at Mobile, Ala.; Beaumont, Tex.; Astoria, Oreg.; and Olympia, Wash. Construction of mooring devices was initiated at the reserve fleet site at Wilmington, N. C. Facilities for installation of commercial power for ventilating grain ships were installed at Hudson River reserve fleet site.

Major dredging operations were completed for the Department of the Navy, with funds transferred from that agency, for shore protection at United States Naval Air Missile Test Center, Point Mugu, Port Hueneme, Calif. Inspection of dredging work was performed at Frog Mortar Creek, Md., for that agency, and an estimate of cost of dredging a channel in Pensacola Bay, Fla., was prepared.

Dredging operations were performed at the boat basin at Jacksonville, Fla., for the United States Coast Guard.

Revetment work was accomplished at Rouge River, Oreg., for the Bureau of Reclamation.

9. FOREIGN TECHNICAL ASSISTANCE

During the fiscal year the Corps of Engineers continued to participate in the United States Foreign Technical Assistance Program sponsored by the Department of State and the International Cooperation Administration (formerly the Foreign Operations Administration).

The study of the Paraguay River for possible development for navigation was completed and a comprehensive report thereon, with recommendations, was furnished the International Cooperation Administration for the use of that agency and the Government of Paraguay. Technical assistance to the French Government in connection with the construction of a large earth dam near Gap, France, was continued. Experts were detailed to France to advise French Government officials in connection with that project and to assist in the selection of a dam site on the Konkouri River in French Guinea, Africa. Technical personnel were also detailed during the year to consult with and advise the Governments of Brazil, Canada, India, Ireland, Liberia, and Pakistan in connection with various projects for flood control, beach erosion prevention, and navigation improvements.

Work was continued on the projects sponsored by the International Cooperation Administration for the procurement, delivery, and assembly of 8 dredges and attendant plant for the Government of Indochina and for 5 dredges and attendant plant for the Government of the Philippines. One of the completed dredges was delivered to the Philippines and placed in operation; 7 of the dredges were delivered

to Indochina and of these, 3 were placed in operation. In addition, under sponsorship of the International Cooperation Administration, a surplus seagoing hopper dredge, complete with spare parts and patterns, was sold to the Government of Thailand.

Under projects sponsored by the International Cooperation Administration, selected engineers from the Governments of India, Pakistan, and the Philippines were received and provided training by the Corps of Engineers in flood control, harbor, and power engineering for periods ranging from 10 weeks to 6 months with the view of aiding those countries in developing their own water resources. In addition, the Corps of Engineers received foreign Government representatives and engineers from various nations and afforded them the opportunity to visit construction projects to study modern construction methods and continued, also, to make available upon request, engineering information to foreign Governments and engineers on a diversity of subjects in the field of water resource development.

10. PUBLICATIONS OF THE CORPS OF ENGINEERS

The following publications pertaining to Civil Works activities were issued during the fiscal year 1955:

A. Available at the Government Printing Office, Washington 25, D. C. at indicated price.

1. Port Series:
   No. 6—Port of Albany, N. Y., revised 1954 ..... $0.65
2. Transportation Series:
   No. 3—Transportation Lines on the Great Lakes, 1955 ..... .60
   No. 4—Transportation Lines on Mississippi and Gulf Intracoastal Waterway, 1955 ..... 1.50
   No. 5—Transportation Lines on Atlantic, Gulf, and Pacific Coast, 1954 ..... 2.50
3. Hopper Dredge, Its History, Development and Operation, Frederick C. Scheffauer, Editor and Chief 4.00

B. Available at place of publication at indicated price.

1. Great Lakes Pilot, 1955. U. S. Lake Survey, Detroit 26, Mich 2.25
2. List of Publications of the Waterways Experiment Station, 1 January 1955. The Waterways Experiment Station, Vicksburg, Miss ..... Gratis
3. Waterborne Commerce, calendar year 1953:
   Part 1—Waterways and Harbors: Atlantic Coast. New England Division, Corps of Engineers, Boston, Mass 1.25
   Part 2—Waterways and Harbors: Gulf Coast, Mississippi River System and Antilles. Lower Mississippi Valley Division, Corps of Engineers, Vicksburg, Miss 1.00
   Part 3—Waterways and Harbors: Great Lakes. U. S. Lake Survey, Detroit 26, Mich ..... .60
   Part 4—Waterways and Harbors: Pacific Coast, Alaska, and Pacific Islands. San Francisco District, Corps of Engineers, San Francisco 19, Calif ..... .50

3. Waterborne Commerce, calendar year 1953—Continued
   Part 5—National Summaries: U. S. Lake Survey, Detroit 26, Mich., or U. S. Government Printing Office, Washington 25, D. C. $0. 35
4. Water Resources Development by Corps of Engineers. (In the 48 States and the District of Columbia) 1 January 1955 ..... Gratis

State:	*Publication Agency (Division)*
Alabama	South Atlantic.
Arizona	South Pacific.
Arkansas	Lower Mississippi.
California	South Pacific.
Colorado	Missouri River.
Connecticut	New England.
Delaware	North Atlantic.
District of Columbia	Do.
Florida	South Atlantic.
Georgia	Do.
Idaho	North Pacific.
Illinois	North Central.
Indiana	Ohio River.
Iowa	North Central.
Kansas	Southwestern.
Kentucky	Ohio River.
Louisiana	Lower Mississippi Valley.
Maine	New England.
Maryland	North Atlantic.
Massachusetts	New England.
Michigan	North Central.
Minnesota	Do.
Mississippi	Lower Mississippi Valley.
Missouri	Missouri River.
Montana	Do.
Nebraska	Do.
Nevada	South Pacific.
New Hampshire	New England.
New Jersey	North Atlantic.
New Mexico	Southwestern.
New York	North Atlantic.
North Carolina	South Atlantic.
North Dakota	Missouri River.
Ohio	Ohio River.
Oklahoma	Southwestern.
Oregon	North Pacific.
Pennsylvania	North Atlantic.
Rhode Island	New England.
South Carolina	South Atlantic.
South Dakota	Missouri River.
Tennessee	Ohio River.
Texas	Southwestern.
Utah	South Pacific.
Vermont	New England.
Virginia	North Atlantic.
Washington	North Pacific.

State—Continued	*Publication Agency (Division)*
West Virginia	Ohio River.
Wisconsin	North Central
Wyoming	Missouri River.

Division addresses:

Lower Mississippi Valley Division, P. O. Box 80, Vicksburg, Miss.
Missouri River Division, P. O. Box 1216, Omaha 1, Nebr.
New England Division, 150 Causeway St., Boston 14, Mass.
North Atlantic Division, 90 Church St., New York 7, New York.
North Central Division, 536 South Clark St., Chicago 5, Ill.
North Pacific Division, 210 Custom House, Portland 9, Oreg.
Ohio River Division, P. O. Box 1159, U. S. Post Office and Custom House, Cincinnati 1, Ohio.
South Atlantic Division, P. O. Box 1889, Old P. O. Bldg., Atlanta 1, Ga.
South Pacific Division, P. O. Box 3339, Rincon Annex, San Francisco 19, Calif.
Southwestern Division, 1114 Commerce St., Dallas 2, Tex.

Chapter III

BENEFITS OF THE PROGRAM

1. *Navigation.* The historical policy of the United States has been and is to develop and maintain its waterways to promote its commerce and industry. The Federal program for improving the Nation's rivers and harbors, now in its 132d year, has produced one of the best systems of harbors, channels and inland waterways in the world. These navigation improvements carry a huge tonnage of valuable foreign and interstate commerce. The availability and use of water transportation have lowered prices by keeping the overall transportation bill of the Nation low, and has thus benefited all of the people, whether they live, work or operate businesses on navigable waters or some distance therefrom. As such, water transportation serves a most useful purpose in the overall economy of the Nation. This work was assigned by Congress to the Corps of Engineers and represents the oldest phase of the activity of the Corps of Engineers in water resource development.

The navigation element of the civil works program consists of three major parts: Coastal harbors and channels, Great Lakes Harbors and channels, and the inland and intracoastal waterways. The following analyses of that program, based on 1953 costs and waterborne commerce, were presented to the Senate Public Works Committee in April 1955 and are considered to be generally representative of the present situation.

Coastal harbors and channels. Improvement of these harbors and channels by the Federal Government has been a progressive development keeping pace with the growth of maritime commerce and the requirements of development of shipping. Natural facilities have been improved over the years from the relatively shallow depths necessary to serve sailing craft, to the greater depths required with the advent of steam shipping, and finally to handle the ocean carriers of today. As a result depths of 35 feet generally prevail at major harbors on the Atlantic and Gulf coasts, ranging up to 45 feet in New York Harbor, and depths of from 30 to 40 feet are generally available on the west coast. Harbors and channels of lesser depth have also been provided for commercial and sport fishing, general recreational boating, and for use as harbors of refuge.

Commerce handled by coastal harbors and channels in the last quarter of a century has shown a steady increase from 307 million tons in 1929 to 480 million tons in 1954. A recent analysis of major

coastal ports, given in table 16, indicates the small cost of the Federal improvements per ton of traffic. While these figures will vary somewhat from year to year it is believed that costs given fairly reflect current conditions.

Table 16. Traffic and Annual Costs—Major Coastal Ports [1]

Harbor	Traffic (millions of tons)	Annual cost (thousand dollars)			Cost per ton (dollars)
		Capital	Maintenance	Total	
Portland, Maine	11. 7	70	[3] 40	110	0. 009
Boston	18. 1	506	124	630	. 035
New York	139. 4	4, 081	2, 123	6, 204	. 045
Delaware River	73. 4	1, 252	2, 733	3, 985	. 054
Baltimore	41. 8	346	278	624	. 015
Norfolk	24. 1	228	174	402	. 017
Newport News	12. 3	44	[3] 13	57	. 005
Mobile	13. 1	42	475	517	. 039
Mississippi River-Baton Rouge to Gulf	[2] 55. 4	892	1, 807	2, 699	. 049
New Orleans	(39. 6)				
Baton Rouge	(15. 8)				
Lake Charles [4]	15. 9	258	[3] 282	540	. 034
Sabine Neches Waterway (including Beaumont and Port Arthur	56. 7	551	754	1, 305	. 023
Houston	44. 3	522	715	1, 237	. 026
Texas City	14. 8	82	[3] 164	246	. 017
Port Aransas-Corpus Christi Waterway	23. 5	230	403	633	. 027
Corpus Christi (included in waterway)	(13. 5)				
Port Aransas (included in waterway)	(10. 0)				
Los Angeles	19. 7	1, 070	[3] 125	1, 195	. 061
San Francisco	37. 7	212	818	1, 030	. 027
Portland, Oreg. [5]	11. 7	198	[3] 1, 604	1, 802	. 154
Seattle	11. 9	6	[3] 59	65	. 005
Total	625. 5	10, 590	12, 691	23, 281	. 037

[1] From data presented to Senate Public works Committe in April 1955, based on 1953 costs and traffic.
[2] Includes only portion of traffic at ports of New Orleans and Baton Rouge.
[3] Current estimate of annual maintenance.
[4] Data for Calcasieu River and Pass.
[5] Data for Columbia and Lower Willamette Rivers below Portland.

Great Lakes. The Great Lakes system serving the Middle West is the world's largest and busiest inland waterway. Eight States border on the Lakes, and nine others are directly tributary thereto. The Lakes have a total water surface area of about 95,000 square miles, two-thirds of which are in the United States. These vast water areas,

joined by the connecting channels, provide a low-cost transport artery that permits the movement of bulk materials and products of every description in huge quantities to advantageously located manufacturing areas. Controlling depths in the connecting channels are generally 21 feet in upbound and 25 feet in downbound channels.

This important transportation system is connected with the Gulf of Mexico by means of 9-foot barge navigation on the improved Illinois and Mississippi Rivers, and with the Atlantic Ocean by means of the New York, State Barge Canal and the Hudson River, and by the 14-foot Canadian St. Lawrence Canals. The St. Lawrence Seaway, when completed in 1959, will give the Lake ports access to the sea lanes of the world via channels having a minimum depth of 27 feet.

The Federal Government has constructed 37 major harbors on the Great Lakes for use by large modern vessels engaged in the movement of basic commodities. In addition to the harbors improved by the Federal Government, there are also seven harbors serving deep-draft navigation which have either been improved by non-Federal interests or which in their natural state adequately serve as harbors. There are also numerous other harbors improved by the Federal Government which are of lesser importance. Among the 10 leading ports of the United States, including coastal ports, Duluth-Superior ranked second only to New York, and Chicago and Toledo were 8th and 9th, respectively, based on 1954 tonnage. A recent analysis of certain major Great Lakes ports is given in table 17.

*Table 17. Traffic and Annual Costs—Major Great Lakes Ports**

	1953 traffic (millions of tons)	Annual cost (thousand dollars)		Total (thousand dollars)	Cost/ton (dollars)
		Capital	Maintenance		
Great Lakes Harbors:					
Duluth-Superior, Minn–Wis	77. 2	147	220	367	0. 005
Two Harbors, Minn	23. 6	117	4	121	. 005
Chicago, Ill	38. 3	69	57	126	. 003
Indiana Harbor, Ind	20. 0	129	41	170	. 008
Detroit, Mich	25. 5	761	167	928	. 036
Toledo, Ohio	31. 6	165	312	477	. 015
Lorain, Ohio	11. 8	91	206	297	. 025
Cleveland, Ohio	23. 5	581	633	1, 214	. 052
Ashtabula, Ohio	15. 2	91	165	256	. 017
Conneaut, Ohio	16. 1	115	164	279	. 017
Buffalo, N. Y	22. 0	168	304	472	. 021
Total	304. 8	2, 434	2, 273	4, 707	. 015

*From data presented to Senate Public Works Committee in April 1955, based on 1953 costs and traffic.

Inland and Intracoastal Waterways. Inland and Intracoastal Waterways, the third element of the navigation program, are one of the most important parts of the national transportation structure. They have proved their worth, both in peace and war, as routes for low-cost movement of bulk commodities to supplement the major forms of overland transport.

The Federal Government has improved in varying degrees some 22,600 miles of waterways in this country to provide the most extensive inland navigation system in the world. The major inland and intracoastal system, however, consists generally of those waterways having a total length of about 8,300 miles which afford the 9- to 12-foot depths needed by modern barge navigation. Traffic on the inland waterway system has grown tremendously during the past 26 years, from 8.6 billion ton-miles in 1929 to 82.5 billion ton-miles in 1954, an increase of about 860 percent during that period. It has been conservatively estimated that the entire inland system in 1953 had an over-all benefit-cost ratio of 3.17. A recent economic evaluation of 12 major waterways is given in table 18.

Table 18. Current Use and Economic Status of Twelve Major Active Waterways [1]

	Length miles	First cost through fiscal year 1953 [2]	Annual cost—1953			Traffic and savings				
			Capital	Maintenance	Total	Tons (millions)	Ton-miles (billions)	Unit savings (mills/ton-mile)	Total savings (million dollars)	1953 B/C ratio
Warrior	472	25.3	0.9	0.9	1.8	2.9	0.65	8.4	5.5	3.1
Gulf Intracoastal	1,367	53.8	1.9	3.7	5.6	41.7	7.4	11.2	83.2	14.8
Lower Mississippi	736	200.0	7.1	4.5	11.6	24.2	12.0	9.1	109.9	9.5
Middle Mississippi	195	80.3	2.8	1.8	4.6	15.9	2.4	8.4	20.0	4.4
Upper Mississippi	663	161.7	5.7	4.4	10.1	14.7	2.6	8.1	21.4	2.1
Illinois	336	28.4	1.0	1.9	2.9	20.1	3.3	6.9	23.1	8.1
Ohio	981	128.2	4.5	7.9	12.4	62.0	11.8	7.7	90.5	7.3
Cumberland	513	8.8	.3	.7	1.0	2.5	.29	12.4	3.6	3.6
Kanawha	91	22.9	.8	.3	1.1	7.4	.39	8.2	3.2	2.9
Monongahela	128	35.5	1.3	1.5	2.8	33.4	1.6	16.0	25.6	9.4
Allegheny	72	18.4	.6	.4	1.0	3.7	.07	19.1	1.4	1.4
Sacramento	245	12.8	.5	.4	.9	2.0	.12	35.8	4.4	5.3
Total	5,799	776.1	27.4	28.4	55.8	230.5	42.62	[3] 9.2	391.8	[3] 7.0

[1] From data presented to Senate Public Works Committee in April 1955, based on 1953 costs and traffic.
[2] First cost is exclusive of old work superseded and not part of current project.
[3] Average.

2. *Flood control.* Federal interest in flood control began in the Alluvial Valley of the Mississippi when the Corps of Engineers first became involved in navigation improvements on that river early in the 19th century, and when the interrelationship of flood control and navigation became apparent. The Federal interest and active Federal participation took definite form with establishment of the Missis-

sippi River Commission in 1879. The first expansion of the Federal interest in flood control outside of the Alluvial Valley of the Mississippi occurred in 1893, when Congress authorized work for control of floods and mining debris on the Sacramento River in California. The first major Federal participation in flood control began in 1928, however, when Congress adopted the present project for flood control and navigation in the Alluvial Valley of the Mississippi River.

In the decade following 1927, the Corps of Engineers carried out the so-called "308 surveys" which provided for the first time a relatively complete inventory of the problems and potentialities of most of the major rivers of the country. These studies and reports included flood control as a major feature but did not recommend flood-control improvements as there was at that time no Federal participation on a nationwide basis. The general plans developed, however, proved of great use during the work relief programs of the depression years of the 1930's and numerous flood-control improvements were undertaken by the Federal Government under these emergency programs. In 1936 Congress adopted the first general Flood Control Act which expanded the Federal interest in flood control on a nationwide basis. As a result of that act and of the earlier 1928 Mississippi River Act, Congress has authorized over 700 projects with a total estimated cost of about $9 billion which comprise the present active flood-control program.

Substantial progress has been made on that program, but the flood problem is still an urgent matter. It is estimated that Federal projects complete or in partial operation prevent annual flood damages of about $500 million, based on the degree of river-basin development generally prevailing in 1954. Additional damages of over $200 million would be prevented by the remainder of the authorized flood-control program when completed, but about $200 million in flood damages will still remain after completion of the authorized flood-control program. The flood damage figures cited apply only to the main river and major tributary valleys of the country, and do not include the losses that occur in the smaller upstream tributaries, estimated by the Department of Agriculture to aggregate about $300 million annually; nor do they include the impact of major floods of 1954 and 1955. The regional distribution of the flood problem and the estimated effect of the Federal flood-control program are given in table 19 and chart IV.

Evaluation of flood control projects in full or partial operation. As of 30 June 1954, 391 projects had been placed in full or partial operation for flood control. Those projects, which have been in operation on the average for a period of 11 years, have prevented flood damages totaling about $7.3 billion, already over twice the total Federal appropriations for their construction.

Table 19. Estimated Effect of Federal Flood-Control Program [1] *(July 1954 price levels and conditions of development)*

Region	Average annual flood damages [2]—(in millions of dollars)					
	Potential without Federal works	To be prevented by works				Remainder
		In full or partial operation	Under construction not in operation	Authorized but not started	Total	
New England	21.0	7.3	-------	4.5	11.8	9.2
North Atlantic	47.9	15.3	5.3	10.8	31.4	16.5
South Atlantic [3]	32.0	8.1	.1	.6	8.8	23.2
Great Lakes Basin	11.5	2.1	.1	.6	2.8	8.7
Ohio River Basin	112.0	46.6	10.0	34.3	90.9	21.1
Upper Mississippi Valley [4]	119.1	75.5	2.0	13.8	91.3	27.8
Lower Mississippi Valley	218.5	214.6	-------	-------	214.6	3.9
Red River of the North	2.6	.8	.2	.4	1.4	1.2
Missouri River Basin [4]	60.0	28.8	10.3	18.8	57.9	2.1
Arkansas-White-Red	52.3	26.6	2.3	5.6	34.5	17.8
Gulf Southwest	55.4	11.7	1.0	14.7	27.4	28.0
Pacific Northwest	67.1	19.3	.8	21.0	41.1	26.0
Pacific Southwest	111.6	34.7	51.3	12.1	98.1	13.5
Total U. S	911.0	491.4	83.4	137.2	712.0	199.0

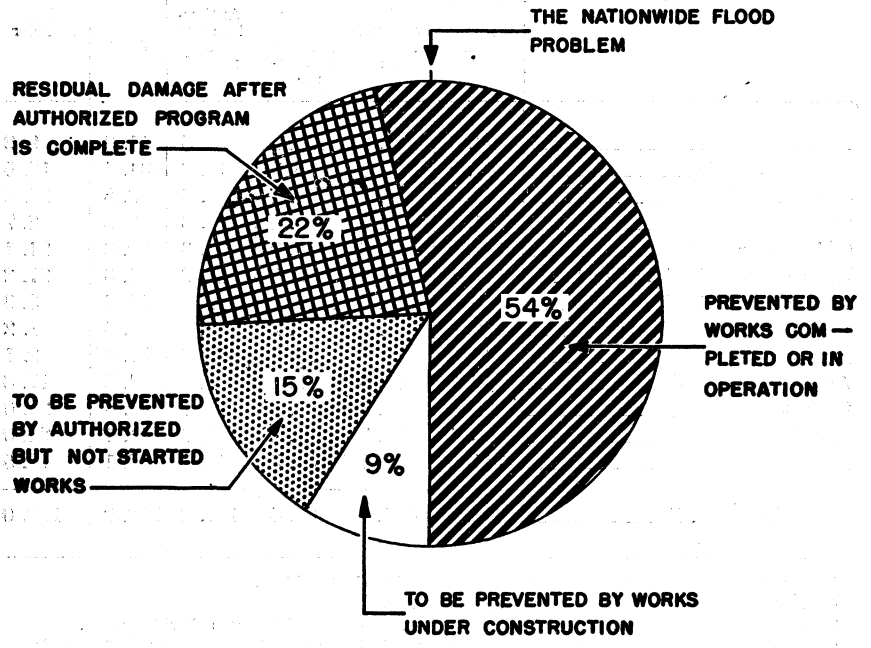
[1] From data presented to Senate Public Works Committee in April 1955.
[2] Do not include impact of major floods in 1954 and 1955.
[3] Flood damages and benefits being reevaluated for entire central and southern Florida project.
[4] Flood damages and benefits being reevaluated to include data obtained during 1951 and 1952 floods.

The value of this program, however, may best be established by relating its economic cost, including interest and amortization of the total investment, both Federal and local, and the annual cost of maintenance and operation, to the estimated average annual benefits for the assumed economic life. For an assumed economic life of 50 years, it is estimated that this group of projects will produce annual benefits of over three times the total annual charge for amortization, interest and maintenance and operation.

Detailed information is given in tables 20 and 21.

3. *Other benefits.* The aforementioned flood-control and navigation benefits alone do not represent the total benefits realized from the civil works program. Large additional benefits also accrue through conservation and use of our water resources by multiple-purpose development. These include development of hydroelectric power, storage of water for industrial, municipal and agricultural use, and the numerous benefits which result from improvement of low river flows. In many cases the projects also provide large public recre-

THE EFFECT OF THE FEDERAL FLOOD CONTROL PROGRAM OF THE CORPS OF ENGINEER



NOTE: EXCLUSIVE OF FLOOD DAMAGES IN SMALL UPSTREAM TRIBUTARIES ESTIMATED BY DEPT. OF AGRICULTURE AT $300 MILLION ANNUALLY.

Chart IV

ational values and opportunities for preservation of fish and wildlife resources.

a. Hydroelectric power. The position of hydroelectric power development in the civil works program has grown with the increasing needs of the Nation for electric energy, with the greater knowledge accumulated in recent years of the ability of rivers to supply that power, and as a result of the expanding Federal interest in its regulation development and use.

The civil works program which involves development of the waters of our major rivers has naturally afforded large possibilities for the development of water power. At projects constructed and operated by the Corps of Engineers, 12.64 billion kilowatt hours were generated during the fiscal year, representing approximately 11.7 percent of the hydroelectric power produced and 2.5 percent of the total production by all sources of the Nation's utility systems. Details on hydroelectric power production at Corps of Engineers projects are contained in chapter II, paragraph 4.

Table 20. Flood Damages Prevented Through 30 June 1954 by Federal Projects in Full or Partial Operation [1]

[Cumulative in millions of dollars]

Region	Number of projects in operation	Average number of years in operation	Total Federal appropriations for new work through 30 June 1954	Accumulated flood damages prevented
New England	23	8.7	52.4	64.3
North Atlantic	34	9.7	175.4	[2] 82.1
South Atlantic	11	10.0	127.7	58.6
Great Lakes Basin	8	3.6	31.7	2.1
Ohio River Basin	76	8.0	470.5	[3] 205.0
Upper Mississippi Valley	61	23.5	73.7	254.8
Lower Mississippi Valley:				
Alluvial Valley	4	27.0	849.9	5,000.0
Other	2	7.0	16.4	0.9
Total Lower Mississippi Valley	6	20.3	866.3	5,000.9
Red River of the North	3	1.7	10.5	3.3
Missouri River Basin	26	12.0	448.0	975.0
Arkansas-White-Red	36	9.0	431.2	97.6
Gulf Southwest	17	2.3	141.3	[4] .9
Pacific Northwest	73	9.5	226.6	118.0
Pacific Southwest	17	7.2	149.1	453.3
Grand total	391	11.0	3,204.4	7,315.9

[1] From data presented to Senate Public Works Committee in April 1955.

[2] Does not include estimated $5.0 million damages prevented during Hurricane Hazel in October 1954.

[3] In addition, Ohio Basin projects operated during the October 1954 and March 1955 floods prevented flood damages estimated at $164.0 million and $69.0 million, respectively. (Total $233.0 million in 6 month period.)

[4] Projects have been in operation during period of severe drought.

*Table 21. Economic Analysis of Federal Flood Control Projects in Full or Partial Operation**

[In millions of dollars]

Region	Estimated first cost (July 1954 estimate)			Average annual charge	Average annual benefits based on July 1954 conditions and price levels			Benefit-cost ratio
	Federal	Local	Total		Flood damages prevented	Other	Total	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
New England	53.9	5.1	59.0	2.7	7.3		7.3	2.5
North Atlantic	180.4	5.0	185.4	9.0	15.3	5.9	21.2	4.0
South Atlantic	222.6	33.0	255.6	13.2	8.1	41.9	50.0	3.8
Great Lakes	31.7	4.4	36.1	1.4	2.1	.2	2.3	1.6
Ohio River Basin	476.9	17.3	494.2	21.1	46.6	15.7	62.3	3.0
Upper Mississippi Valley	119.0	19.8	138.8	5.5	75.5		75.5	13.7
Lower Mississippi Valley	1,347.8	42.3	1,390.1	64.9	214.6	98.8	313.4	4.8
Red River of the North	10.6	.7	11.3	.5	.8	.4	1.2	2.4
Missouri River Basin	669.1	26.1	695.2	33.5	28.8	29.1	57.9	1.7
Arkansas-White-Red	636.3	11.1	647.4	32.4	26.6	24.5	51.1	1.6
Gulf Southwest	159.1	14.0	173.1	7.5	11.7	5.6	17.3	2.3
Pacific Northwest	247.2	1.7	248.9	12.0	19.3	11.2	30.5	2.5
Pacific Southwest	170.4	111.7	282.1	12.0	34.7	9.0	43.7	3.6
Grand total	4,325.0	292.2	4,617.2	215.7	491.4	242.3	733.7	3.4

*From data presented to Senate Public Works Committee in April 1955.

b. Water supply and streamflow regulation. Droughts experienced in the last 10 years, population increases, and growing demands of manufacturing processes have focused the attention of the public on the need for adequate amounts of water of a suitable quality. Consumptive use of water for domestic, industrial, and agricultural purposes is a major consideration in comprehensive planning for optimum development of water resources in all of the country's river basins. The Corps of Engineers has general legislative authority to modify reservoirs to provide additional storage for domestic water supply or other conservation storage, on condition that local interests pay the cost of such additional storage, and to make contracts with States, municipalities, local agencies, and individuals, for surplus water that may be available at Civil Works projects. In addition, water supply features have been included in project authorization acts and, in instances where water supply storage would encroach upon authorized project purposes, authorization has been obtained by special legislation after the need has been established. Under these authorities several communities have availed themselves of the opportunity of obtaining needed water supplies, and the Corps of

Engineers is providing about 940,000 acre-feet of storage space in the interest of domestic and industrial water supply in 13 reservoirs which serve approximately 30 towns and cities. The projects, water supply storage, and local agency concerned are shown in the following tabulation:

Water Supply Storage Provided by Corps of Engineers

Project	Water supply Storage acre-feet	Local agency
San Angelo, Tex	80, 351	Upper Colorado River Authority.
Berlin Dam, Ohio	19, 400	Mahoning Valley Sanitary District.
Mosquito Creek, Ohio	11, 000	Warren, Ohio.
Burr Oak, Ohio (Tom Jenkins)	9, 300	State of Ohio.
Hords Creek, Tex	5, 780	Coleman, Tex.
Garza-Little Elm, Tex	415, 000	Dallas, Tex.
Do	21, 000	Denton, Tex.
Grapevine, Tex	85, 000	Dallas, Tex.
Do	50, 000	Park Cities, Tex.
Do	1, 250	Grapevine, Tex.
Lavon Dam, Tex	100, 000	North Texas Municipal Water District.
Delaware Dam, Ohio	5, 700	Columbus, Ohio.
Texarkana Ark., and Tex	13, 400	Cities of Texarkana, Ark., and Tex.
Lake Texoma, Okla. and Tex	21, 300	Denison, Tex.
Belton, Tex	12, 000	Fort Hood, Tex.
Canton Dam, Okla	90, 000	Oklahoma City, Okla.
Total	940, 481	

Under basic authorizations, Corps of Engineers' examination and survey reports may include such other uses as may be properly related to or coordinated with proposed navigation and flood control projects. In that connection, the formulation of comprehensive water resources plans may include irrigation among the other uses which may be incorporated into a flood-control or navigation project. Irrigation storage space in Corps of Engineers' reservoirs falls into two categories, one in which storage space is allocated exclusively to irrigation use, and the other where, due to existing seasonal patterns of flood runoff, irrigation may share storage with flood control or other project functions. There are about 3,975,000 acre-feet of storage space being operated either exclusively or jointly for irrigation and

other uses as are shown in the following tabulation showing project, and storage classification:

Irrigation Storage—in Operation—Corps of Engineers' Reservoirs

Project	Exclusive irrigation storage acre-feet	Joint-use storage acre-feet
John Martin, Colo	384, 000	----------
Harlan County, Nebr	150, 000	----------
Conchas, N. Mex	279, 000	----------
Folsom, Calif	----------	512, 000
Pine Flat, Calif	----------	1, 000, 000
Isabella, Calif	----------	535, 000
Lucky Peak, Idaho	----------	280, 000
Cottage Grove, Oreg	----------	30, 000
Dorena, Oreg	----------	70, 000
Fern Ridge, Oreg	----------	95, 000
Lookout Point, Oreg	----------	340, 000
Detroit, Oreg	----------	300, 000
Total	813, 000	3, 162, 000

Besides storage capacity providing for domestic, industrial, and irrigation uses, there are numerous cases where reservoirs are operated for low-flow regulation in the interest of navigation and other purposes. Low-flow regulation releases also provide incidental multiple benefits such as water supply at downstream localities, pollution abatement, recreation, and fish and wildlife along the streams.

In view of continued drought conditions and below-normal stream flows that prevailed over most of the Central and Southwestern United States during the first part of the fiscal year, Division and District Engineers were authorized to utilize a portion of the flood control storage in reservoir projects, where feasible, in order to provide storage for water for conservation and low flow regulation of the streams. This adjustment in reservoir operation was authorized as an emergency measure only.

The operation of Corps of Engineers' reservoirs relieved deficient streamflow at many localities. On the Missouri River the release of water from Fort Peck, Garrison, and Fort Randall Reservoirs augmented natural flows to sustain a desirable flow downstream for navigation, municipal water supply and pollution abatement. Similarly, reservoirs in the Southwest were operated to maintain adequate storage for augmentation of water supply for emergency municipal and industrial use in the event local storage and natural river flows were inadequate for these purposes.

Due to improved conditions the emergency adjustment in reservoir operation was terminated on 31 December 1954.

4. *Public use of project areas.* The use of Civil Works projects for fishing, boating, swimming, hunting, camping, picknicking, and other outdoor recreation activities increased to about 54 million visitor days during the year 1954. This represents approximately 14 million more visitor days than was reported for the calendar year 1953. Although some of the attendance increase resulted from the new projects placed in operation during the year, most of the other reservoir areas continued to show substantial increases in public recreation use over previous years.

The large public recreation use continued to generate noticeable economic and social changes, particularly in the perimeter areas of the larger multiple-purpose reservoirs. These changes include a noticeable increase in new and improved public roads and other utilities needed to accommodate the large number of people utilizing the recreational resources created by the projects. Increased county tax assessments reflect the large private investments made in new commercial service facilities, restaurants, and overnight accommodations. The sale of boats and boating accessories alone reflect large increases in trade. New employment incident to recreational improvements and services is substantial in overall employment figures.

Additional areas adjoining many reservoirs have been leased to State agencies for public park, recreation, and conservation use. A number of counties have initiated recreational development and management of some of the public use areas around the reservoirs. Notable progress has been made in enlisting local cooperation in forming "safety councils" to teach proper boat handling and methods of avoiding drownings incidental to swimming, boating, and fishing in the waters of the projects.

Approximately 150 nonprofit, quasi-public agencies are now providing for summer camping on lands leased to them in reservoir areas of the Corps.

In addition to the substantial facilities provided by State and local governmental agencies to accommodate the public at Corps of Engineers' projects, the authorized concessionaires at these projects have during 1955 added more service facilities, such as boats, overnight accommodations, and restaurants to serve the public adequately.

5. *Fish and wildlife.* Full consideration is given to fish and wildlife resources in cooperation with State and Federal fishery and wildlife agencies in all stages of project planning, construction, and operation. Completed flood-control and navigation projects are continuing to provide increasing and unprecedented fish and wildlife benefits in the form of newly created fish and wildlife resources, improved stream conditions, food and cover, and grounds for public

hunting and fishing, refuges, and for State and Federal fish and wildlife improvement programs. These benefits affect all parts of the Nation and in some important respects, such as effects upon waterfowl, their influences are continental. More than 4 million acres of land and water area have been made available for the first time for these purposes, and it is estimated that approximately 25 million man-days of hunting and fishing were provided during 1955. State and Federal fish and wildlife programs were being carried out during the year on approximately 1,000,000 acres on 102 project areas in 31 States under long-term leases granted by the Secretary of the Army without charge to the administering agency. These areas are about equally divided between State-administered wildlife programs and additions to the Federal wildlife refuge system. Revenues received by the State and Federal wildlife agencies from public use of fish and wildlife resources in connection with these projects exceed the costs of their administration and development for fish and wildlife purposes in many areas and thereby provide an additional source of funds for wildlife management outside of the project areas.

Chapter VII

ECONOMY MEASURES

1. ORGANIZATION, METHODS AND PROCEDURES

Effective steps were taken during the year to produce increased efficiency and economy in the supervision and administration of the Civil Works program as well as in operational performance through improved organizations and procedures and by changes in working methods. Sound business management efforts have been intensified to provide an offsetting factor against higher price levels and increasingly complex water resource problems. Significant economies have been realized.

Organization. In September 1954 the Upper Mississippi Valley Division office was abolished due to decreased workload, and its functions were merged with those of the Lower Mississippi Valley Division and the Great Lakes Division (renamed North Central Division). An estimated annual saving of $130,000 is being obtained from this action. In May 1955 the Duluth and Milwaukee district offices were reduced to the status of area offices of the St. Paul and Chicago districts, respectively, with resulting estimated savings of $270,000 annually. At the end of the year a reorganization of area offices in the Galveston district was put into effect. By consolidating and reducing functions the number of area offices was reduced from 6 to 4, the Houston and Port Lavaca offices having been closed and the Port Arthur office continued with a smaller staff. Annual savings of $100,000 are estimated from these moves.

During the year the number of offices handling civilian payrolls was reduced by consolidating these activities in a single district for each division. For maximum economy this organizational change was accompanied by the staggering of pay periods and the replacement of manual accounting methods with mechanized accounting. Of the substantial reduction in personnel requirements achieved through these changes, an estimated saving of $220,000 per annum is applicable to Civil Works.

A further reduction in costs of about $140,000 annually was accomplished during fiscal year 1955 by the streamlining of activities conducted by the supervisor of New York Harbor, resulting in lower personnel and plant requirements. Total benefits of $860,000 annually are expected from the foregoing major improvements in organization.

Procedures Improvement. Following extensive studies of all pro-

cedures involved in property accounting and administration, there was put into effect during the year a streamlined revision of the entire operation providing economy-producing simplification and elimination of duplication while retaining adequate controls and protection. Among the major concepts embodied in the change were: (*a*) Elimination of perpetual item accounting after issue for items having an original cost each of less than $25.00 and (*b*) elimination of duplication in the accounting for an item on more than one accounting record. Benefits resulting from reduced personnel effort and travel expenses are estimated at $370,000 per annum.

A major cost reduction in fiscal year 1955 resulted from an intensive records disposal drive throughout the Corps of Engineers. Over 180,000 linear feet of records were retired or destroyed and some 8,000 items of filing equipment were released as surplus. Of the benefits realized from reductions in space, maintenance costs, and personnel, it is estimated that about $475,000 were applicable to Civil Works activities.

Improved procedures in the collection and publication of statistical data on the water-borne commerce of the United States effected during the year will provide savings of about $100,000 annually. This economy measure accomplished by consolidating collection responsibilities in four regional offices instead of in individual district offices, by streamlining reports and by using improved printing methods is the more significant considering that it represents a reduction of about 12 percent in the total costs of these operations.

Dredging Efficiency. During the year, unwatering and degassing systems were installed on two additional hopper dredges. The improved effectiveness and efficiency attained resulted in annual savings estimated at $70,000.

Existing hopper dredges were converted to radically different type plants which were put into service for dredging and rehandling soft material in the Delaware River. Based on the first 6 months' operation, the superiority of the new rehandling system has been unquestionably demonstrated by the permanent retention of greatly increased yardages disposed of ashore. The improved condition of the sections of the navigation channel in which the converted equipment has been assigned furnishes conclusive evidence of the benefits that have accrued. The estimated annual savings are upwards of $1,000,000.

2. CIVIL WORKS INVESTIGATION PROGRAM

During the last 8 years, the Corps of Engineers has conducted a program of investigations aimed at improving design and construction procedures for and decreasing the costs of civil works projects. A large portion of this program has been administered and accomplished by the Waterways Experiment Station, the Corps' principal labora-

tory for the conduct of technical investigations, model testing, and development work in such fields as hydraulics, soil mechanics, and concrete. It is estimated that direct savings in construction costs which have resulted from the Civil Works Investigations Program amount to several million dollars annually. Some typical examples are described in the paragraphs which follow.

Wind Tides and Waves. Studies in connection with Lake Okeechobee and the central and southern Florida project have produced improved methods of determining the magnitude of wind tides and the height of waves which can be expected in shallow bodies of water. Prior to completion of these studies the freeboard requirements for earth levees were determined by uncertain methods which may have contributed to unsafe design or unnecessary cost for conservatism. As a measure of the importance of accurately determining freeboard and at the same time avoiding overdesign, it can be pointed out that the cost of constructing levees on the central and southern Florida project is estimated at $4,000,000 per foot of levee height.

Reservoir Clearing. Field studies of operating reservoirs have revealed that complete clearing of timber and thorough clean-up in reservoirs before filling is not necessary for the successful control of floatable material. Application of the results of this investigation to current and future construction will result in an annual saving of about $2,000,000. A related experimental project is the development of floating power shears for more economical clearing above a desired elevation as a reservoir is being filled.

Navigation Locks. Model and prototype investigations have provided criteria for the design of improved filling systems for high-lift locks. Old type systems created too much turbulence under high head which made it necessary to slow the filling rate, thus causing loss of valuable time to navigation interests. It has been computed that each 1-minute reduction in filling time of a lock has the same effect as providing $25,000 to $100,000 worth of additional transport vessels. A new type filling system, which will reduce lockage time by as much as 10 minutes, has been developed and is incorporated in the design of several new locks.

Borehole Photography. This newest tool in the field of foundation exploration has been refined and developed to eliminate much of the uncertainty which usually attends the interpretation of incomplete core recoveries from small-diameter borings. In the past it has been necessary to resort to large-diameter calyx bores to provide access for visual inspection of questionable foundation zones. Calyx borings cost up to 20 times as much as the small-diameter borings. The present procedure is to completely photograph the walls of the small borings with a conical-mirror camera using color film. The film is projected on a cylindrical screen and the observer is thus able to view

by small segments the full-scale reproduction of the entire surface of a bore hole from top to bottom. During the past year bore-hole photography has been substituted for costly calyx drilling in the foundations of Old Hickory powerhouse, the St. Lawrence River navigation locks, Table Rock Dam, and many other projects with an estimated saving of $400,000.

Rubble-mound Breakwaters. In the past, rubble-mound breakwaters have largely been designed by obtaining the largest cap-rock available at reasonable cost. A scientific method of design, incorporating known safety factors, was needed in order that full economic use could be made of available materials. Model studies were conducted to define the forces of waves on rubble structures. These studies have yielded data from which modifying coefficients have been developed to improve the Iribarren design formula. The modified formula is now satisfactory for designing safe and economical structures. Its use will result in considerable savings in construction and maintenance costs.

Paints and Protective Coatings. Investigations of commercially available paints and protective coatings suitable for application to hydraulic structures and of improved techniques for preparation of surfaces and application have increased the useful service life of coatings from about 2 years to as much as 8 years. Resulting savings are estimated to be $500,000 annually.

Concrete Batching Plants. A test program was conducted to obtain performance data on commercially available batching controls and recorders for concrete batching plants. The investigation produced data which resulted in revisions to guide specifications to permit more practical contract application; it promoted better relationships with manufacturers by presenting the Corps' requirements and evaluating the equipment by these requirements, and it is expected to broaden competition to supply equipment under future contracts.

Chapter VIII

WATERBORNE COMMERCE OF UNITED STATES

A total of 867.1 million tons was reported for calendar year 1954 as compared with 923.5 million tons in 1953. The major decline occurred in the commerce on the Great Lakes which accounted for 91.5 percent of the total decrease in tonnage.

Total ton-miles of freight carried on the inland waterways correspondingly decreased from 202.4 billion in 1953 to 166.6 billion in 1954. This decrease, however, occurred entirely on the Great Lakes system where ton-miles fell from 127.4 billion to 91.2 billion. Ton-miles on the Mississippi River system were unchanged at 42 billion.

Leading individual coastal ports by geographical regions included:

Harbor	*Millions of tons of 2,000 pounds*
Boston	17. 9
New York	137. 4
Philadelphia	40. 3
Baltimore	38. 4
Norfolk	26. 2
New Orleans	40. 6
Port Arthur	19. 9
Houston	43. 2
Los Angeles	20. 0
Portland, Oreg	11. 3
Seattle	11. 6

The coastal areas having a concentration of harbors include the following; the tonnages shown are gross totals:

Coastal area	*Millions of tons of 2,000 pounds*
Delaware River from Trenton, N. J., to the sea	89. 3
Hampton Roads, Va	37. 8
San Francisco Bay	42. 8
Columbia and Lower Williamette Rivers, Oregon and Washington	16. 8

Among the leading individual Great Lakes ports were:

Harbor	*Millions of tons of 2,000 pounds*
Duluth-Superior	49. 1
Two Harbors (Agate Bay), Minn	14. 3
Milwaukee	7. 8
Chicago	34. 1
Indiana Harbor	17. 4
Detroit	21. 2
Toledo	27. 5
Erie	5. 3
Buffalo	18. 8

There are presented in the following tabulations the national summaries of the waterborne commerce of the United States and the territories and possessions during the calendar year 1954, including the tonnages handled at ports and harbors and moved on the waterways and canals improved by the Corps of Engineers as authorized by Congress. Detailed data on the commodities handled and the vessel trips at the ports and on the individual waterways are contained in the following five separate publications, which may be purchased from the sales agent of the Superintendent of Documents, United States Lake Survey, Corps of Engineers, United States Army, 630 Federal Building, Detroit 26, Mich.:

Waterborne Commerce of the United States, Calendar Year 1954:

Part 1—Atlantic Coast.

Part 2—Gulf Coast, Mississippi River System, and Antilles.

Part 3—Great Lakes.

Part 4—Pacific Coast, Alaska, and Pacific Islands.

Part 5—National Summary.

The terms applied to the kinds of traffic are explained in each of these regional publications.

Authorization for the collection of these data is contained in various river and harbor acts enacted by the Congress through the years, the principal authorization being section 11 of the River and Harbor Act of 22 September 1922. While the information as now collected and compiled is designed to meet the administrative requirements of the Corps of Engineers in connection with the prosecution of the navigation program as required by the Congress, it also provides necessary and vital data for other governmental departments, commercial and shipping concerns, and others interested in transportation.

Table 27. Total Waterborne Commerce of the United States, Calendar Years 1947–54

[In millions of tons of 2,000 pounds]

Year	Total	Foreign						Domestic						
		Imports			Exports			Total	Coastwise	Lakewise	Internal	Intraport	Local	Intraterritory
		Total	Coastal ports	Great Lakes ports	Total	Coastal ports	Great Lakes ports							
1947	766.8	62.2	57.4	4.8	126.1	102.0	24.1	578.6	153.1	163.2	149.6	57.4	55.3	(*)
1948	793.2	72.3	68.1	4.2	90.7	65.4	25.3	630.2	174.1	172.5	169.7	58.9	55.0	(*)
1949	740.7	82.0	77.2	4.8	83.4	65.7	17.6	575.4	161.4	145.6	165.7	48.3	54.3	(*)
1950	820.6	102.0	96.3	5.7	67.2	43.6	23.6	651.4	182.5	169.9	190.8	51.7	55.2	1.2
1951	924.1	108.7	101.8	6.9	123.3	97.6	25.7	692.1	186.8	178.5	213.4	51.0	61.1	1.4
1952	887.7	116.0	108.7	7.3	111.4	85.1	26.3	660.4	184.2	154.1	216.6	49.2	54.8	1.5
1953	923.5	128.0	120.6	7.4	89.4	63.8	25.6	706.2	188.8	188.6	225.0	47.9	54.7	1.3
1954	867.1	129.4	123.4	6.0	83.9	65.2	18.6	653.8	187.3	145.4	217.1	48.1	54.6	1.4

*Included in other types of domestic traffic.

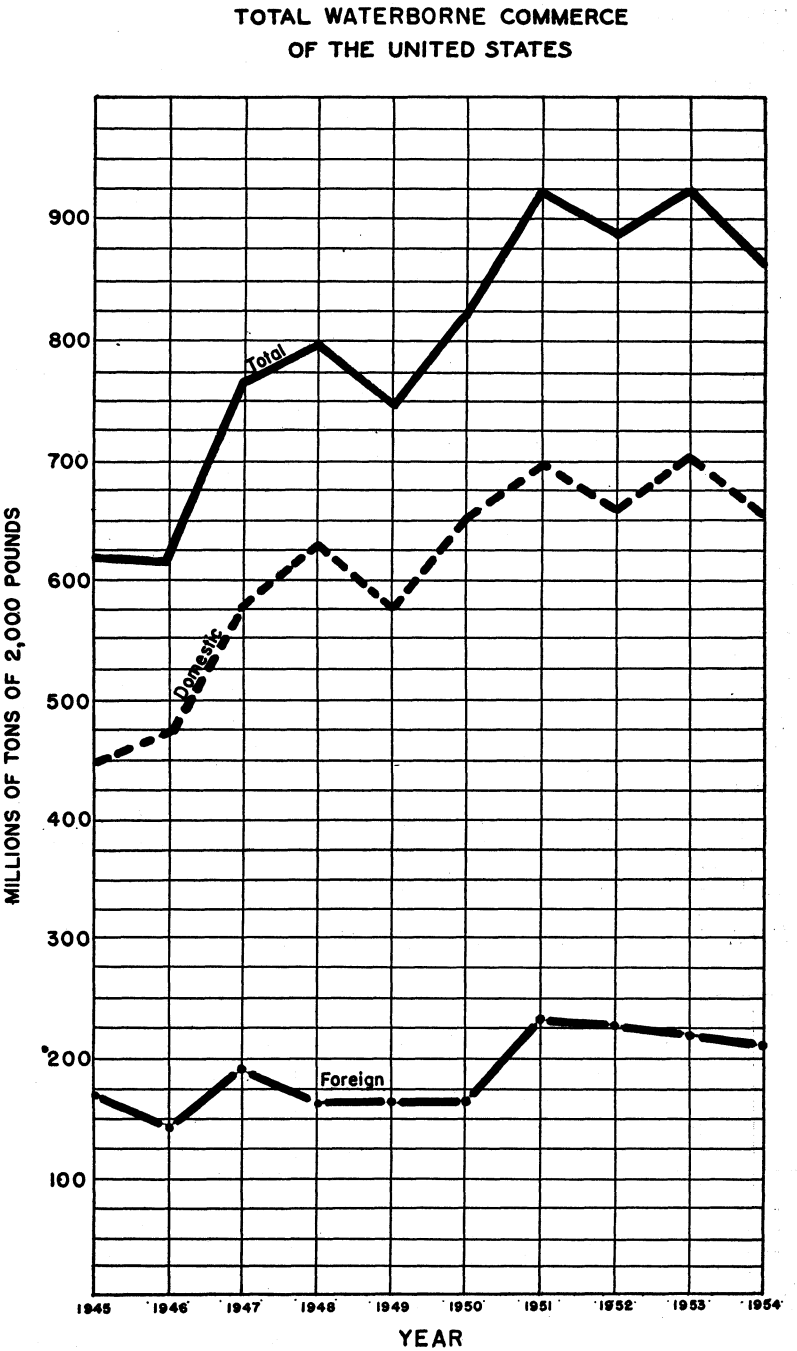

TOTAL WATERBORNE COMMERCE
OF THE UNITED STATES
MILLIONS OF TONS OF 2,000 POUNDS
900
800
700
600
500
400
300
200
100
Total
Domestic
Foreign
1945
1946
1947
1948
1949
1950
1951
1952
1953
1954
YEAR

Chart VIII.

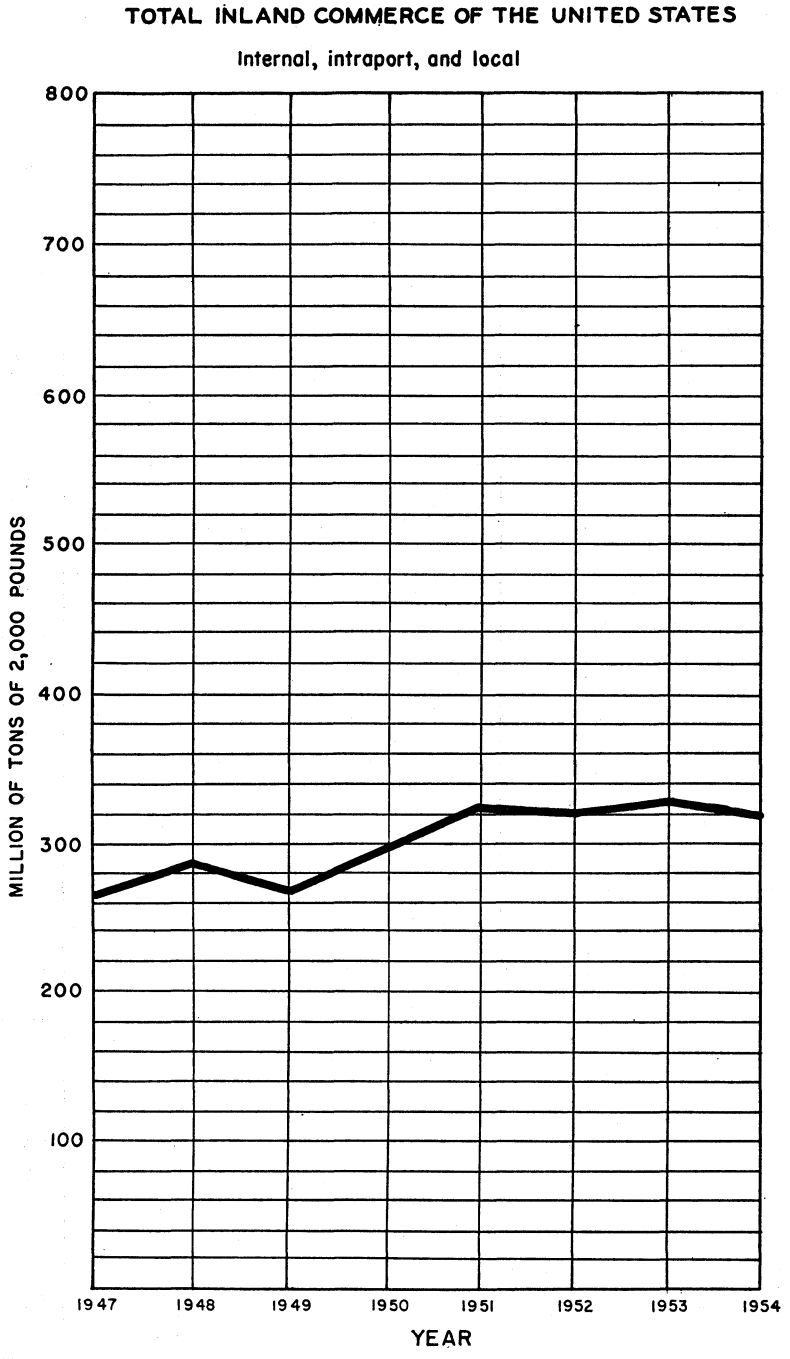

TOTAL INLAND COMMERCE OF THE UNITED STATES
Internal, intraport, and local
MILLION OF TONS OF 2,000 POUNDS
800
700
600
500
400
300
200
100
1947
1948
1949
1950
1951
1952
1953
1954
YEAR

Chart IX.

Table 28. Commerce at Project Harbors, Calendar Year 1954

[In tons of 2,000 pounds]

Note. For those harbors or waterways where commerce is shown for each individual harbor (for example New York Harbor), the total commerce for such harbor or waterway is adjusted to exclude duplications.

Harbor	Tons
OTHER THAN GREAT LAKES	
Bar Harbor, Maine	43
Belfast Harbor, Maine	1,744
Boothbay Harbor, Maine	1,737
Camden Harbor, Maine*	
Cape Porpoise Harbor, Maine	3,120
Corea Harbor, Maine	400
Hendricks Harbor, Maine	483
Isle au Haut Thoroughfare, Maine	603
New Harbor, Maine	430
Northeast Harbor, Maine*	
Portland Harbor, Maine	11,782,242
Rockland Harbor, Maine	91,295
Rockport Harbor, Maine	617
Stonington Harbor, Maine	9,114
Thomaston Harbor, Maine	1
Wood Island Harbor, Maine and the Pool at Biddeford	22
York Harbor, Maine	4
Burlington Harbor, Vt	403,719
Portsmouth Harbor, N. H	905,693
Beverly Harbor, Mass	100,102
Cohasset Harbor, Mass	129
Cuttyhunk Harbor, Mass	268
Dorchester Bay, Mass	11,088
Duxbury Harbor, Mass	760
Edgartown Harbor, Mass.*	
Fall River Harbor, Mass	1,775,297
Gloucester Harbor, Mass	136,837
Harbor of Refuge, Nantucket, Mass	30,063
Hingham Harbor, Mass.*	
Lynn Harbor, Mass	24,818
Main Waterfront, Mass	5,462,953
Manchester Harbor, Mass	243
Marblehead Harbor, Mass.*	
New Bedford and Fairhaven Harbor, Mass	215,336
Newburyport Harbor, Mass	1
Plymouth Harbor, Mass	28,207
Pollock Rip Shoals, Nantucket Sound, Mass.*	
Port of Boston, Mass	17,878,336
Provincetown Harbor, Mass	13,308
Rockport Harbor, Mass	19
Salem Harbor, Mass	1,009,943
Scituate Harbor, Mass	388
Vineyard Haven Harbor, Mass	40,017
Wellfleet Harbor, Mass	582
Great Salt Pond, Block Island, R. I	164
Harbor of Refuge, Block Island, R. I.*	
Harbor of Refuge, Point Judith and Point Judith Pond, R. I	41,633
Newport Harbor, R. I	127,622
Providence River and Harbor, R. I	7,438,570
Wickford Harbor, R. I.*	
Branford Harbor, Conn.*	
OTHER THAN GREAT LAKES—continued	
Bridgeport Harbor, Conn	2,163,654
Clinton Harbor, Conn	92
Duck Island Harbor, Conn.*	
Fivemile River Harbor, Conn	71
Greenwich Harbor, Conn	79,074
Milford Harbor, Conn	2,797
New Haven Harbor, Conn	6,294,807
New London Harbor, Conn	961,410
Norwalk Harbor, Conn	275,639
Southport Harbor, Conn.*	
Stamford Harbor, Conn	729,791
Stonington Harbor, Conn	7,637
Westport Harbor and Saugatuck River, Conn	12,925
Albany, N. Y	6,397,846
Greenport Harbor, N. Y	25,713
Hay (West) Harbor, N. Y	80
Hempstead Harbor, N. Y	5,144,580
Huntington Harbor, N. Y	206,257
Lake Montauk Harbor, N. Y	1,881
Mattituck Harbor, N. Y	59,661
New York Harbor, N. Y. and N. J.:	
Port Chester Harbor, N. Y	501,885
Milton Harbor, N. Y	22,705
Mamaroneck Harbor, N. Y	102,066
Echo Bay, N. Y	109,082
New Rochelle Harbor, N. Y	3,480
Long Island Sound at City Island, N. Y	905
East Chester Creek, N. Y	2,069,603
Westchester Creek, N. Y	791,006
Bronx River, N. Y	595,436
Manhasset Bay, N. Y	1,113,289
Flushing Bay, N. Y	2,468,851
Harlem River, N. Y	2,046,791
Hudson River, N. Y. (lower section)	1,028,436
Hudson River Channel, N. Y. and N. J	21,845,864
East River, N. Y	17,355,508
Newtown Creek, N. Y	7,738,317
Wallabout Channel, N. Y	238,795
Buttermilk Channel, N. Y	2,578,785
Bay Ridge and Red Hook Channels, N. Y	4,983,177
East Rockaway Inlet, N. Y. (Debs Inlet)*	
Gowanus Creek Channel, N. Y	4,677,953
Gravesend Bay, N. Y	655,288
Matawan Creek, N. J.*	
Coney Island Creek, N. Y	110,644
Coney Island Channel, N. Y.*	
Sheepshead Bay, N. Y	3,958
Channel between Hoffman and Swinburne Islands, N. Y.*	
Cheesequake Creek, N. J.*	

* No commerce report.

Table 28. Commerce at Project Harbors, Calendar Year 1954—Continued

[In tons of 2,000 pounds]

Harbor	Tons
OTHER THAN GREAT LAKES—continued	
New York Harbor—Continued	
Jamaica Bay, N. Y	4,044,791
Lemon Creek, Staten Island, N. Y	2,343
Keyport Harbor, N. J.*	
Great Kills, Staten Island, N. Y	1,000
Shoal Harbor and Compton Creek, N. J	122,384
Raritan River, N. J	5,060,835
Washington Canal and South River, N. J	60,716
Woodbridge Creek, N. J	37,175
Elizabeth River, N. J	15,326
Rahway River, N. J	178,087
Upper Bay, N. Y. and N. J	5,831,104
Sandy Hook Bay, N. J	107,982
Newark Bay, N. J	7,009,390
Hackensack River, N. J	4,370,817
Passaic River, N. J	8,984,877
New York and New Jersey Channels, N. Y. and N. J	68,267,312
Raritan River to Arthur Kill Cut-Off Channel, N. J	7,802
Unadjusted total	175,143,765
Net total	137,353,454
Northport Bay and Harbor, N. Y	2,095,998
Peekskill Harbor, N. Y	176,713
Plattsburg Harbor, N. Y	219,636
Port Henry Harbor, N. Y	13,918
Port Jefferson Harbor, N. Y	1,054,165
Roundout Harbor, N. Y	458,070
Sag Harbor, N. Y	21,481
Saugerties Harbor, N. Y.*	
Tarrytown Harbor, N. Y	744,783
Alliquippa-Rochester, Pa	6,621,829
Clairton-Elizabeth, Pa	10,693,056
Pittsburgh, Pa	8,302,847
Delaware River and tributaries, Trenton, N. J. to the sea:	
Trenton Harbor, N. J	465,439
Bordentown-Fieldsboro, N. J	1,894
Burlington-Florence-Roebling, N. J	749,487
Riverton-Delanco-Beverly, N. J	521,842
Penn Manor, Pa., and vicinity	5,832,549
Bristol, Pa., and vicinity	24,449
Philadelphia Harbor, Pa	40,278,970
Camden-Gloucester, N. J	2,773,884
Chester, Pa	1,050,386
Marcus Hook, Pa., and vicinity	20,549,384
Paulsboro, N. J., and vicinity	13,661,727
Thompson Point, N. J., and vicinity	240,287
Wilmington Harbor, Del	2,478,737
Pennsgrove-Carney Point, N. J	222,567
New Castle, Del., and vicinity	2,216
Artificial Island, N. J., and vicinity	63,288

Harbor	Tons
OTHER THAN GREAT LAKES—continued	
Delaware River and tributaries—Con.	
Lower Delaware Bay, N. J	235,396
Lower Delaware Bay, Del	153,277
Unadjusted total	89,305,779
Net total	78,997,127
Annapolis Harbor, Md	18,817
Baltimore Harbor and Channels, Md	38,434,302
Black Walnut Harbor, Md	637
Breton Bay, Md	9,434
Cambridge Harbor, Md	102,371
Claiborne Harbor, Md	269
Crisfield Harbor, Md	57,788
Ocean City Harbor and Inlet and Sinepuxent Bay, Md	7,123
Queenstown Harbor, Md	21
Rock Hall Harbor, Md	5,663
Tilghman Island Harbor, Md	1,278
Washington Harbor, D. C	2,542,240
Cape Charles City Harbor, Va	5,515
Channel to Newport News, Va	11,590,696
Horn Harbor, Va	20,276
Monroe Bay and Creek, Va	4,157
Norfolk Harbor, Va	26,211,832
Port of Richmond, Va	2,469,090
Portsmouth Harbor, Va., Channel to Nansemond Ordnance Depot*	
Potomac River at Alexandria, Va	304,812
Winter Harbor, Va	1,850
Beaufort Harbor, N. C	55,945
Belhaven Harbor, N. C	12,670
Edenton Harbor, N. C	23,756
Manteo (Shallowbag) Bay, N. C	14,620
Morehead City Harbor, N. C	504,205
Silver Lake Harbor, N. C	2,881
Charleston Harbor, S. C	3,419,929
Georgetown Harbor (Winyah Bay), S. C	968,634
Brunswick Harbor, Ga	202,328
Darien Harbor, Ga	601
Savannah Harbor, Ga	3,751,841
Appalachicola Bay, Fla	48,040
Bayou Chico, Fla	47,049
Canaveral Harbor, Fla	4,873
Carrabelle, Fla	27,307
Cedar Keys Harbor, Fla	1,036
Charlotte Harbor, Fla	1,120,364
Eau Gallie Harbor, Fla	1,050
Fernandina Harbor, Fla	204,890
Fort Pierce Harbor, Fla	56,206
Jacksonville Harbor, Fla	5,267,749
Key West Harbor, Fla	112,477
Melbourne Harbor, Fla	63
Miami Harbor, Fla	2,619,778
Palm Beach Harbor, Fla	824,193

* No Commerce report.

Table 28. Commerce at Project Harbors, Calendar Year 1954—Continued

[In tons of 2,000 pounds]

Harbor	Tons
OTHER THAN GREAT LAKES—continued	
Panama City Harbor, Fla	1,253,523
Pensacola Harbor, Fla	702,091
Port Everglades Harbor, Fla	2,884,258
Port St. Joe Harbor, Fla	1,893,160
St. Augustine Harbor, Fla	5,119
St. Petersburg Harbor, Fla	218,739
Tampa Harbor, Fla	9,812,962
Chickasaw Creek, Ala	186,607
Mobile Harbor, Ala	13,873,167
Three Mile Creek, Ala	3,882,174
Baton Rouge, La	14,574,571
Lake Charles, La. (Calcasieu River and Pass, La.).	14,282,382
New Orleans, La	40,560,350
Terrebonne Bay, La.*	
Biloxi Harbor, Miss	161,660
Greenville, Miss	1,205,079
Gulfport Harbor, Miss	189,177
Pascagoula Harbor, Miss	286,147
Pass Christian Harbor, Miss	273
Vicksburg, Miss	523,700
Beaumont, Tex	22,684,282
Brazos Island Harbor, Tex	2,073,348
Brownsville, Tex	1,245,461
Corpus Christi, Tex	14,915,183
Freeport, Tex	3,743,760
Galveston, Tex. (Galveston Channel Tex.).	4,444,833
Houston, Tex. (Houston Ship Channel Tex.).	43,244,841
Orange, Tex	1,192,008
Port Aransas, Tex	8,409,997
Port Arthur, Tex	19,925,081
Port Isabel, Tex	855,141
Rockport, Tex	9,219
Sabine Pass Harbor, Tex	187,395
Texas City, Tex. (Texas City Channel, Tex.).	14,388,797
Port Mansfield, Tex	6,305
Helena, Ark	2,020,837
Chattanooga, Tenn	629,129
Knoxville, Tenn	917,849
Memphis, Tenn	3,561,413
Nashville, Tenn	1,790,197
Kansas City, Mo	224,808
St. Louis, Mo	5,926,958
Cincinnati, Ohio	7,021,625
Louisville, Ky	5,357,589
Huntington, W. Va	10,714,604
Baudette Harbor, Minn	10
Minneapolis, Minn	446,090
St. Paul, Minn	2,340,268
Warroad Harbor, Minn	550
Mt. Vernon, Ind	3,071,406
Crescent City Harbor, Calif	379,996
Humboldt Harbor and Bay, Calif	419,857
Long Beach Harbor, Calif	5,865,993
Los Angeles Harbor, Calif	19,999,378
Monterey Harbor, Calif	94,526
Morro Bay Harbor, Calif	1,238
Moss Landing Harbor, Calif	139,860
Newport Bay Harbor, Calif	6,383
San Diego Harbor, Calif	1,532,913
San Francisco Bay Area, Calif.:	
San Rafael Creek	81,031
Petaluma Creek	293,724
Napa River	110,542
Carquinez Strait	7,491,725
Suisun Channel	27,855
Suisun Bay Channel	4,035,691
San Pablo Bay and Mare Island Strait.	5,549,165
Richmond Harbor	13,373,650
Oakland Harbor	3,554,672
Newark Slough	9,113
Alviso Slough	77,876
Redwood City Harbor	2,475,295
San Francisco Harbor	3,919,464
San Francisco Bay Area, other ports	1,790,829
Unadjusted total	42,790,632
Net total	35,765,846
Santa Barbara Harbor, Calif	6,413
Stockton, Calif	1,602,331
Coos Bay, Oreg	2,860,794
Oregon Slough, Oreg	649,169
Ports on Columbia and Lower Willamette Rivers:	
Portland, Oreg	11,336,975
Vancouver, Wash	1,562,618
St. Helens, Oreg	540,193
Longview, Wash	2,082,704
Astoria, Oreg	415,721
Other ports on the Columbia River	904,496
Tillamook Bay and Bar, Oreg	147,098
Yaquina Bay and Harbor, Oreg	386,960
Anacortes Harbor, Wash	501,246
Bellingham Bay and Harbor, Wash	1,600,577
Everett Harbor, Wash	2,624,967
Grays Harbor and Chehalis River, Wash.	1,724,198
Hammersley Inlet, Wash	1,289,827
Neah Bay, Wash	93,269
Olympia Harbor, Wash	1,166,705
Port Angeles Harbor, Wash	2,169,449
Port Gamble, Wash	337,932
Seattle Harbor, Wash	11,587,360
Tacoma Harbor, Wash	4,478,553
Willapa River and Harbor, Wash	533,389
Arecibo Harbor, P. R	15
Fajardo Harbor, P. R	153,679
Guayanes Harbor, P. R	14,190

*No Commerce report.

Table 28. Commerce at Project Harbors, Calendar Year 1954—Continued

[In tons of 2,000 pounds]

Harbor	Tons
OTHER THAN GREAT LAKES—continued	
Mayaguez Harbor, P. R.	458,978
Ponce Harbor, P. R.	706,770
San Juan Harbor, P. R.	2,633,049
Christiansted Harbor, St. Croix, V. I.	25,917
St. Thomas Harbor, V. I.	122,288
Hilo Harbor, T. H.	751,238
Honolulu Harbor, T. H.	3,031,136
Kahului Harbor, Maui, T. H.	619,024
Kaunakakai, Molokai, T. H.	161,050
Nawiliwili Harbor, Kauai, T. H.	372,066
Port Allen Harbor, T. H.	141,322
Wake Island	57,122
Cordova Harbor, Alaska	33,224
Craig Harbor, Alaska	1,131
Iliuliuk Harbor, Alaska	63,268
Juneau Harbor, Alaska	128,085
Ketchikan Harbor, Alaska	550,665
Kodiak Harbor, Alaska	24,249
Metlakatla Harbor, Alaska	8,394
Myers Chuck Harbor, Alaska	(**)
Nome, Alaska	159,787
Petersburg Harbor, Alaska	49,835
Port Alexander, Alaska	72
Seldovia Harbor, Alaska	14,239
Seward Harbor, Alaska	565,013
Sitka Harbor, Alaska	24,595
Skagway Harbor, Alaska	63,850
Valdez Harbor, Alaska	96,278
Whittier, Alaska	120,606
Wrangell Harbor, Alaska	53,502
GREAT LAKES	
Beaver Bay Harbor, Minn.	20
Duluth-Superior Harbor, Minn. and Wis.	49,116,365
Grand Marais Harbor, Minn.	50,031
Knife River Harbor, Minn.	75
Lutsen Harbor, Minn.	3
Two Harbors (Agate Bay), Minn.	14,308,238
Algoma Harbor, Wis.	2,738
Ashland Harbor, Wis.	4,448,919
Bayfield Harbor, Wis.	3,279
Cornucopia, Wis.	836
Detroit Harbor, Wis.	6,553
Green Bay Harbor, Wis.	3,377,455
Jackson Harbor, Wis.	1,336
Kenosha Harbor, Wis.	19,157
Kewaunee Harbor, Wis.	1,052,455
Manitowoc Harbor, Wis.	2,239,558
Menominee Harbor, Wis.	772,922
Milwaukee Harbor, Wis.	7,781,559
Oconto Harbor, Wis.	58
Pensaukee Harbor, Wis.	275
Port Washington Harbor, Wis.	1,041,173
Port Wing Harbor, Wis.	224
Racine Harbor, Wis.	103,295
Sheboygan Harbor, Wis.	486,892
Two Rivers Harbor, Wis.	120,928
Algonac, Mich.	150,622
Alpena Harbor, Mich.	3,071,818
Big Bay Harbor, Mich.	2
Black River Harbor, Mich.	20
Charlevoix Harbor, Mich.	55,448
Cheboygan Harbor, Mich.	42,997
Detour, Mich.	273,936
Drummond Island, Mich.	2,433,128
Frankfort Harbor, Mich.	1,597,035
Gladstone Harbor, Mich.	145,360
Grand Haven Harbor and Grand River, Mich.	6,267,991
Grand Marais, Mich.	163
Grand Traverse Bay Harbor, Mich.	322
Harbor Beach, Mich., Harbor of Refuge	41,933
Holland Harbor, Mich.	217,408
Isle Royale, Mich.	1,154
Keweenaw Waterway, ports on	397,756
Lac La Belle Harbor, Mich.	30
Leland Harbor, Mich.	1,128
Lime Island, Mich.	153,767
Ludington Harbor, Mich.	3,228,528
Manistee, Mich.	424,470
Manistique Harbor, Mich.	290,937
Marine City, Mich.	107,136
Marquette Harbor, Mich.	530,200
Marysville, Mich.	390,979
Monroe Harbor, Mich.	44,315
Muskegon Harbor, Mich.	3,138,261
Ontonagon Harbor, Mich.	39
Pentwater Harbor, Mich.	67
Port Huron, Mich.	1,124,071
Port of Detroit, Mich.	21,211,941
Port of Sault Ste Marie, Mich.	399,962
Presque Isle Harbor, Mich.	3,479,001
St. Clair, Mich.	1,281,561
St. James Harbor (Beaver Island), Mich.	1,408
St. Joseph Harbor, Mich.	350,502
Saugatuck Harbor and Kalamazoo River, Mich.	137
South Haven Harbor, Mich.	61,108
Traverse City Harbor, Mich.	132,680
Whitefish Point Harbor, Mich.	219
White Lake Harbor, Mich.	12,530
Port of Chicago, Ill.	31,674,992
Waukegan Harbor, Ill.	70,413
Indiana Harbor, Ind.	17,407,937
Michigan City Harbor, Ind.	192
Ashtabula Harbor, Ohio	8,271,833
Cleveland Harbor, Ohio	15,466,664
Conneaut Harbor, Ohio	10,134,545
Fairport Harbor, Ohio	2,567,719
Huron Harbor, Ohio	2,523,110
Lorain Harbor, Ohio	7,659,670

**Not available.

Table 28. Commerce at Project Harbors, Calendar Year 1954—Continued

[In tons of 2,000 pounds]

Harbor	Tons	Harbor	Tons
GREAT LAKES—continued		GREAT LAKES—continued	
Port Clinton Harbor, Ohio	5,644	Great Sodus Bay Harbor, N. Y	1,373,597
Sandusky Harbor, Ohio	8,165,445	Niagara Falls, N. Y	49,741
Put In Bay, Ohio	5,986	Ogdensburg Harbor, N. Y	523,257
Toledo, Ohio	27,549,366	Oswego Harbor, N. Y	1,983,596
Vermilion Harbor, Ohio	656	Rochester (Charlotte) Harbor, N. Y	708,169
Erie Harbor, Pa	5,319,747	Sackets Harbor, N. Y	33,907
Buffalo, N. Y	18,786,129	Tonawanda Harbor, N. Y	564,642
Dunkirk Harbor, N. Y	17,340	Waddington Harbor, N. Y	95,990

Table 29. Ton-mileage of Freight Carried on the Inland Waterways of the United States, by System, Calendar Year 1954

System	Ton-miles
Atlantic coast waterways [1]	22,909,399,000
Gulf coast waterways	12,479,509,000
Pacific coast waterways	4,317,574,000
Mississippi River system, including Ohio River and tributaries	42,609,492,000
Other waterways	6,075,000
Great Lakes system [2]	91,174,887,000
Total	173,496,936,000

[1] Includes approximately 6.7 billion ton-miles not included in previous years.
[2] Does not include traffic between foreign ports.

Note. Ton-miles for canals and connecting channels, shown for previous years in this table as a separate category, have been distributed by inland waterway system.

Table 30. Commerce on Project Waterways, Calendar Year 1954

[In tons of 2,000 pounds]

Waterway	Tons	Total ton-miles (000 omitted)
Josias River, Maine	470	
Kennebec River, Maine	213,254	5,035
Kennebunk River, Maine	755	1
Lubec Channel, Maine	88,385	152
Penobscot River, Maine	821,908	20,268
Saco River, Maine [1]		
St. Croix River, Maine	26,021	426
Union River, Maine [1]		
Otter Creek, Vt.[1]		
Annisquam River, Mass	2	
Cape Cod Canal, Mass	12,929,751	226,271
Chelsea River, Mass	5,024,597	7,534
Fort Point Channel, Mass	449,581	225
Ipswich River, Mass	2,012	6
Malden River, Mass	36,924	37
Merrimack River, Mass.[1]		

[1] No commerce reported.

Table 30. Commerce on Project Waterways, Calendar Year 1954—Continued

[In tons of 2,000 pounds]

Waterway	Tons	Total ton-miles (000 omitted)
Mystic River, Mass	5,395,906	4,920
Neponset River, Mass	12,086	12
Taunton River, Mass.[1]		
Town River, Mass	662,544	497
Weymouth Back River, Mass	30,825	15
Weymouth Fore River, Mass	1,877,570	10,510
Woods Hole Channel, Mass	36,573	33
Pawcatuck River, R. I. and Conn	10,529	69
Sakonnet River and Harbor, R. I	3,833	19
Seekonk River, R. I	302,669	605
Warren River, R. I	1,197	1
Connecticut River above Hartford, Conn.[1]		
Connecticut River below Hartford, Conn	2,400,269	110,412
Housatonic River, Conn	706,185	3,531
Mianus River and Cos Cob Harbor, Conn	22,962	23
Mystic River, Conn	169	
Thames River, Conn	749,514	10,929
Browns Creek, N. Y	200	
Fire Island Inlet, N. Y	103,642	155
Glen Cove Creek, N. Y	78,663	79
Great South Bay, N. Y	108,267	1,823
Hudson River, Deep Water in Upper Bay, N. Y., to Waterford, N. Y. (consolidated report)	40,004,675	1,597,386
Hudson River, N. Y., mouth of Spuyten Duyvil Creek) to Waterford, N. Y	18,527,282	1,597,767
Jones Inlet, N. Y	3,613	8
Long Island Intracoastal Waterway, N. Y	3,261	111
Narrows of Lake Champlain, N. Y. and Vt	754,988	10,192
New York State Barge Canal	3,859,335	560,804
Niagara River, N. Y	2,811,001	
Orowoc Creek, N. Y	1,464	1
Patchogue River, N. Y	98,616	74
Peconic Bay and River, N. Y	4,443	85
Wappinger Creek, N. Y	7,265	11
Absecon Creek, N. J	257	1
Absecon Inlet, N. J	138,734	277
Alloway Creek, N. J.[1]		
Barnegat Inlet, N. J.[1]		
Big Timber Creek, N. J	288,001	86
Cape May Canal, N. J	1,555	6
Cohansey River, N. J	167,790	3,207
Cold Spring Inlet, N. J	22,666	23
Cooper River, N. J	279,444	279
Delaware River at Camden, N. J	2,091,474	
Dennis Creek, N. J.[1]		
Double Creek, N. J	7	
Goshen Creek, N. J.[1]		
Manasquan River, N. J	1,325	2
Mantua Creek, N. J	148,517	149
Maurice River, N. J	58,494	409
New Jersey Intracoastal Waterway	176,480	1,059
Oldmans Creek, N. J.[1]		
Raccoon Creek, N. J	4,636	42
Rancocas River, N. J	10,172	13
Salem River, N. J	59,799	239
Shark River, N. J.[1]		
Shrewsbury River, N. J.[1]		

[1] No commerce reported.

Table 30. Commerce on Project Waterways, Calendar Year 1954—Continued

[In tons of 2,000 pounds]

Waterway	Tons	Total ton-miles (000 omitted)
Toms River, N. J.[1]		
Tuckerton Creek, N. J.	4,865	15
Waycake Creek, N. J.[1]		
Woodbury Creek, N. J.[1]		
Chester River, Pa.[1]		
Schuylkill River, Pa.	15,418,807	61,675
Appoquinimink River, Del.[1]		
Broad Creek River, Del.	7,402	74
Broadkill River, Del.[1]		
Delaware River, Trenton, N. J., to the sea (consolidated report)	80,239,116	6,870,432
Delaware River between Philadelphia, Pa., and Trenton, N. J.	9,828,473	117,942
Delaware River, Philadelphia, Pa., to the sea	74,487,461	6,193,632
Harbor of Refuge, Delaware Bay, Del.	94,588	142
Indian River Inlet and Bay, Del.	7	
Inland Waterway between Rehoboth Bay and Delaware Bay, Del.	12,954	142
Inland Waterway from Delaware River to Chesapeake Bay, Del. and Md.	8,816,134	405,542
Leipsic River, Del.[1]		
Little River, Del.[1]		
Mispillion River, Del.	24,948	30
Murderkill River, Del.	4,430	9
Nanticoke River (including Northwest Fork), Del. and Md.	206,176	7,997
St. Jones River, Del.[1]		
Smyrna River, Del.	2,216	20
Back Creek (Anne Arundel County), Md.	1,330	
Broad Creek, Somerset County, Md.	5,510	18
Broadwater Creek, Md.	28	
Cadle Creek, Md.[1]		
Channel to Island Creek, St. George Island, M	10	
Chester River, Md.	131,879	3,482
Chincoteague Bay, Md. and Va.	16,493	49
Choptank River, Md.	126,032	1,696
Corsica River, Md.	48,956	245
Duck Point Cove, Md.	2,726	3
Elk and Little Elk Rivers, Md.	124,562	623
Fishing Bay Tributaries, Dorchester County, Md.	3,200	3
Fishing Creek, Calvert County, Md.[1]		
Governors Run, Md.	164	
Hellens Creek, Md.[1]		
Herring Bay and Rockhold Creek, Md.	52	
Honga River and Tar Bay, Md.	8,835	3
Knapps Narrows, Md.	4,987	5
Lake Ogleton, Md.[1]		
La Trappe River, Md.	3,356	12
Lower Thoroughfare at or near Wenona, Deal Island, Md.	5,100	5
Manokin River, Md.	357	1
Middle River and Dark Head Creek, Md.	39	
Mill Creek, Md.	14	
Nanticoke River at Nanticoke, Md.	3,593	4
Neale Sound, Md.	559	1
Northeast River, Md.	282	1
Parish Creek, Md.	639	1
Patuxent River, Md.	86,814	672
Pocomoke River, Md.	57,082	1,712
St. Catherines Sound, Md.	675	1
St. Jerome Creek, Md.	744	1
St. Patricks Creek, Md.	1,432	1
Slaughter Creek, Md.	307	

[1] No commerce reported.

Table 30. Commerce on Project Waterways, Calendar Year 1954—Continued

[In tons of 2,000 pounds]

Waterway	Tons	Total ton-miles (000 omitted)
Smith Creek, Md	6,591	10
Susquehanna River above and below Havre De Grace, Md	15,856	79
Town Creek, Md	5,433	3
Tred Avon River, Md	68,075	681
Twitch Cove and Big Thoroughfare River, Md	2,777	14
Tyaskin Creek, Md	38	----
Upper Thoroughfare, Deal Island, Md	7,675	5
Warwick River, Md	10,470	16
Wicomico River, Md. (Eastern Shore)	293,219	8,724
Anacostia River, D. C	1,477,476	2,955
Potomac River below Washington, D. C	3,573,997	270,431
Potomac River Tributaries	23,515	49
Potomac River, Virginia Channel	1,051,057	4,940
Potomac River, Washington Channel, D. C	13,707	7
Appomattox River, Va.[1]	----	----
Aquia Creek, Va	4	----
Atlantic Intracoastal Waterway between Norfolk, Va., and the St. Johns River, Fla.:		
Norfolk engineer district:		
Via Dismal Swamp Canal Route	60,842	1,679
Via Great Bridge Lock Route	1,045,725	28,444
Wilmington engineer district	1,542,896	117,915
Charleston engineer district	1,197,373	92,796
Savannah engineer district	820,883	45,149
Jacksonville engineer district	638,602	10,332
Blackwater River, Va	43,054	581
Bransons Cove, Va	2,430	----
Broad Creek, Va	1,962	1
Carter Creek, Va	44,303	51
Channel connecting York River, Va., with Back Creek to Slaights Wharf	14,920	15
Channel from Phoebus, Va., to Deep Water in Hampton Roads	3,142	3
Coan River, Va	7,985	16
Cockrell Creek, Va	156,129	234
Cranes Creek, Va	434	----
Davis Creek, Va	1,597	1
Deep Creek, Warwick County, Va	14,063	28
Dymers Creek, Va	34,471	34
Hampton Creek, Va	263,715	738
Hoskins Creek, Va	2,374	2
Jackson Creek, Va	1,071	1
James River, Va	4,689,400	295,432
King Creek, Northampton County, Va	18,462	18
Little Machipongo River, Va	26,303	53
Little River (Creek), Va	118,173	118
Little Wicomico River, Va	3,395	7
Locklies Creek, Va	27,173	41
Mattiponi River, Va	52,510	1,013
Milford Haven, Va	5,000	5
Mill Creek, Va	1,906	2
Mulberry Creek, Va	5,833	3
Nandua Creek, Va	1,578	6
Nansemond River, Va	430,507	3,573
Newport News Creek, Va	301,412	121
Nomini Bay and Creek, Va	10,068	32
Occohannock Creek, Va	1,563	6
Occoquan Creek, Va	2	----
Onancock River, Va	32,751	180

[1] No commerce reported.

Table 30. Commerce on Project Waterways, Calendar Year 1954—Continued

[In tons of 2,000 pounds]

Waterway	Tons	Total ton-miles (000 omitted)
Oyster Channel, Va	27,755	25
Pagan River, Va	28,425	114
Pamunkey River, Va	209,959	314
Quinby Creek, Va	3,952	3
Rappahannock River, Va	333,955	22,348
Starlings Creek, Va	12,558	8
Tangier Channel, Va	3,238	4
Totuskey Creek, Va	17,992	99
Upper Machodoc Creek, Va	2,900	2
Urbana Creek, Va	8,794	4
Waterway on the coast of Virginia	83,871	1,860
Whitings Creek, Va.[1]		
Willoughby Channel, Va.[1]		
York River, Va	342,401	7,875
Bay River, N. C	1,353	16
Black River, N. C.[1]		
Cape Fear River, N. C., above Wilmington	457,855	36,745
Cashie River, N. C	23,000	472
Channel connecting Thoroughfare Bay with Cedar Bay, N. C	299	
Channel from Back Sound to Lookout Bight, N. C	1,249	5
Channel from Pamlico Sound to Avon, N. C	1,422	1
Channel from Pamlico Sound to Rodanthe, N. C	716	1
Chowan River, N. C	74,460	1,427
Contentnea Creek, N. C.[1]		
Drum Inlet, N. C	186	
Far Creek, N. C	11,934	24
Knobbs Creek, N. C	25,847	14
Lockwoods Folly River, N. C	31	
Mackay Creek, N. C	943	
Meherrin River, B. C	4,105	43
Neuse River, N. C	71,774	718
Northeast (Cape Fear) River, N. C	4,437	111
Pamlico and Tar Rivers, N. C	58,163	814
Perquimans River, N. C	8,751	96
Roanoke River, N. C	375,033	11,299
Rollinson Channel, N. C	2,972	9
Scuppernong River, N. C	8,186	65
Shallotte River, N. C	173	
Smiths Creek (Pamlico County), N. C	1,653	2
Smiths Creek (Wilmington), N. C.[1]		
South River, N. C	670	2
Stumpy Point Bay, N. C	640	1
Swift Creek, N. C.[1]		
Trent River, N. C	5,931	18
Waccamaw River, N. C. and S. C	11,581	481
Wallace Channel, Pamlico Sound, N. C	1,361	3
Waterway connecting Pamlico Sound and Beaufort Harbor, N. C	5,336	96
Waterway connecting Swan Quarter Bay with Deep Bay, N. C	1,292	4
Wilmington Harbor, N. C	3,631,641	95,909
Abbapoola Creek, S. C	1,091	5
Ashley River, S. C	8,407	50
Beresford Creek, S. C.[1]		
Congaree River, S. C.[1]		
Great Pee Dee River, S. C	21,000	210
Mingo Creek, S. C.[1]		
Russell Creek, S. C.[1]		
Santee River, S. C.[1]		

[1] No commerce reported.

Table 30. Commerce on Project Waterways, Calendar Year 1954—Continued

[In tons of 2,000 pounds]

Waterway	Tons	Total ton-miles (000 omitted)
Shipyard River, S. C	631,684	632
Altamaha River, Ga	18,895	113
Apalachicola, Chattahoochee and Flint Rivers, Ga. and Fla	122,900	2,381
Fancy Bluff Creek, Ga	20,393	92
Ocmulgee River, Ga.[1]		
Oconee River, Ga.[1]		
St. Marys River, Ga. and Fla	72,715	436
Satilla River, Ga	3,969	127
Savannah River below Augusta, Ga	26,670	5,227
Anclote River, Fla	1,094	9
Bayou Chico, Fla	47,049	50
Blackwater River, Fla	12,911	129
Channel from Naples, Fla., to Big Marco Pass, Fla	9,981	14
Choctawhatchee River, Fla. and Ala.[1]		
Courtenay Channel, Fla.[1]		
Crystal River, Fla	478	4
East Pass Channel from the Gulf of Mexico into Choctawhatchee Bay, Fla	755	
Escambia and Conecuh Rivers, Fla. and Ala., Ecambia Bay, Fla	23,467	540
Gulf County Canal, Fla	36,610	210
Gulf Intracoastal Waterway between Apalachee Bay, Fla., and the Mexican Border	36,982,214	6,564,777
Homosassa River, Fla	478	3
Horseshoe Cove, Fla	44	
Hudson River, Fla	151	
Intracoastal Waterway, Caloosahatchee River to Anclote River, Fla	90,692	1,981
Intracoastal Waterway:		
Jacksonville to Miami, Fla	630,667	44,152
Miami to Key West, Fla	394,181	8,041
Kissimmee River, Fla	1,195	12
La Grange Bayou, Fla	45,352	181
Lake Crescent and Dunns Creek, Fla	174	1
Little Manatee River, Fla	141	1
Manatee River, Fla	55,802	320
Miami River, Fla	901,442	2,182
New River, Fla	1,281	10
Okeechobee Waterway, Fla	86,471	7,514
Oklawaha River, Fla	894	3
Ozona, Fla., channel and turning basin	96	
Palm Beach, Fla., side channel and basin [1]		
Pithlachascotee River, Fla	80	
St. Johns River, Fla., Jacksonville to Lake Harney	522,020	40,430
St. Lucie Inlet, Fla	578	1
St. Marks River, Fla	227,721	1,480
Steinhatchee River, Fla	745	4
Suwanee River, Fla	658	3
Upper Chipola River, Fla., from mouth to Mariana [1]		
Watson Bayou, Fla	87,203	104
Withlacoochee River, Fla	162,810	1,751
Alabama-Coosa Rivers, Ala. and Ga	117,916	6,689
Bayou Coden, Ala	1,503	1
Bayou La Batre, Ala	23,279	55
Black Warrior, Warrior, and Tombigbee Rivers, Ala	3,019,077	762,822
Chickasaw Creek, Ala	186,607	222
Three Mile Creek, Ala	3,882,174	4,562
Waterway connecting the Tombigbee and Tennessee Rivers, Ala. and Miss.[1]		
Amite River and Bayou Manchac, La	6,050	194

[1] No commerce reported.

Table 30. Commerce on Project Waterways, Calendar Year 1954—Continued

[In tons of 2,000 pounds]

Waterway	Tons	Total ton-miles (000 omitted)
Atchafalaya River, La	357,183	16,445
Atchafalaya River, La., Morgan City to Gulf of Mexico	594,432	19,531
Barataria Bay, La	694,695	17,328
Bayou Bartholomew, La. and Ark.[1]		
Bayou Bonfouca, La	12,343	111
Bayou Dupre, La	2,781	17
Bayou Grossetete, La	5,798	56
Bayou Lacombe, La	8,770	44
Bayou Lafourche, La	897,072	18,698
Bayou Little Caillou, La	69,605	965
Bayou Plaquemine Brule, La	90	2
Bayou Queue de Tortue, La.[1]		
Bayou Segnette, La	3,123	20
Bayou Teche, La	267,151	11,815
Bayou Terrebonne, La	1,407,739	6,402
Bayou Vermilion, La	177,834	3,975
Bayous D'Arbonne and Corney, La.[1]		
Bayous La Loutre, St. Malo, and Ysclosky, La	46,852	941
Big Pigeon and Little Pigeon Bayous, La	12,335	166
Boeuf River, La.[1]		
Chefuncte and Bogue Falia Rivers, La	29,605	95
Cypress Bayou and Waterway between Jefferson, Tex., and Shreveport, La.	6,451	58
Franklin Canal, La	9,756	56
Grand Bayou Pass, La.[1]		
Gulf Intracoastal Waterway, Plaquemine to Morgan City Route, La	1,531,931	52,709
Inland Waterway from Franklin to the Mermentau River, La	329,449	6,597
Innerharbor Navigation Canal, La	3,212,327	7,687
Johnsons Bayou, La	30,894	154
Lake Charles Deep Water Channel, La.[2]	14,143,024	352,162
Little River, La.[1]		
Mermentau River, Bayou Nezpique and Bayou Des Cannes, La	1,640,476	48,881
Pass Manchac, La	28,056	196
Petit Anse, Tigre and Carlin Bayous, La	394,530	2,070
Tensas River and Bayou Macon, La	1,760	9
Tickfaw, Natalbany, Ponchatoula, and Blood Rivers, La.[1]		
Vinton Waterway, La	82,703	717
Waterway from Empire, La., to Gulf of Mexico	120,233	830
Waterway from Intracoastal Waterway to Bayou Dulac, La. (Bayous Le Carpe and Grand Caillou)	234,533	3,550
Waterway from White Lake to Pecan Island, La	27,430	49
Bayou Bernard, Miss.[1]		
Bayou Galere, Miss.[1]		
Big Sunflower River, Miss.[1]		
Bluff Creek, Miss	2,556	24
East Pearl River, Miss	54,611	297
Little Sunflower River, Miss.[1]		
Mississippi River:		
Minneapolis, Minn., to the Passes (net)	82,404,001	24,783,308
Minneapolis, Minn., to mouth of Missouri River	16,295,544	2,946,986
Mouth of Missouri River to mouth of Ohio River	17,663,048	2,657,751
Mouth of Ohio River to but not including Baton Rouge, La	25,051,453	12,453,600
Baton Rouge, La., to but not including New Orleans, La	37,116,834	3,305,700
New Orleans, La., to mouth of Passes	54,888,940	3,419,271
Mouth of Yazoo River, Miss	170,777	195
Pascagoula River, Miss	29,168	583

[1] No commerce reported.

[2] Included in Gulf Intracoastal Waterway between Apalachee Bay, Fla., and the Mexican border.

Table 30. Commerce on Project Waterways, Calendar Year 1954—Continued

[In tons of 2,000 pounds]

Waterway	Tons	Total ton-miles (000 omitted)
Pearl River, Miss. and La	86,721	3,473
Steele and Washington Bayous and Lake Washington, Miss.[1]		
Tallahatchee and Coldwater Rivers, Miss.[1]		
Wolf and Jordan Rivers, Miss	31,466	378
Yazoo River, Miss	12,594	34
Anahuac Channel, Tex	474,447	2,287
Bastrop Bayou, Tex	11,364	116
Brazos Island Harbor, Tex. (waterway)	2,073,348	23,447
Cedar Bayou, Tex	550,227	2,678
Channel from Pass Cavallo to Port Lavaca, Tex	515,245	6,730
Channel to Aransas Pass, Tex	134,989	802
Channel to Palacios, Tex	49,793	691
Channel to Port Bolivar, Tex.[1]		
Chocolate Bayou, Tex	115,045	1,760
Clear Creek, Tex	14,224	40
Dickinson Bayou, Tex	263,211	3,000
Double Bayou, Tex	22,065	74
Port Aransas (Aransas Pass)-Corpus Christi, Waterway, Tex	23,076,339	355,354
Sabine-Neches Waterway, Tex	53,523,810	1,218,129
San Bernard River, Tex	1,270,274	31,308
Tributary Arroyo Colorado, Tex	57,876	1,226
Trinity River, Channel to Liberty, Tex	375,802	4,171
Guadalupe River to Victoria, Tex	47,570	433
Arkansas River, Ark. and Okla	432,573	959
Black River, Ark. and Mo.[1]		
Ouachita and Black Rivers, Ark. and La	140,295	20,653
Ouachita River above Camden, Ark.[1]		
Red River below Fulton, Ark	106,466	3,009
St. Francis and L'Anguille Rivers and Blackfish Bayou, Ark	4,948	54
Saline River, Ark.[1]		
Upper White River, Ark	23,900	96
White River, Ark., below Batesville, Ark	164,261	2,681
Cumberland River, Tenn. and Ky	2,233,088	291,289
French Broad and Little Pigeon Rivers, Tenn	99,040	305
Tennessee River, Tenn., Ala., and Ky	8,415,769	1,236,548
Wolf River, Tenn	1,285,232	2,045
Missouri River:		
Fort Benton to the mouth (net)	2,677,325	147,525
Kansas City to the mouth	1,245,135	116,014
Sioux City to Kansas City	1,479,499	31,308
Muskingum River, Ohio	55,120	11
Ohio River, Pittsburgh to mouth	55,076,677	11,556,889
Big Sandy River, Tug and Levisa Forks, Ky., and W. Va	17,292	69
Green and Barren Rivers, Ky	206,625	10,953
Kentucky River, Ky	132,294	11,722
Rough River, Ky.[1]		
Tradewater River, Ky.[1]		
Kanawha River, W. Va	6,369,016	300,241
Little Kanawha River, W. Va	62,574	116
Allegheny River, Pa., improved portion	3,773,074	60,584
Allegheny River, Pa., open-channel portion	94,850	95
Monongahela River, Pa., and W. Va	8,937,364	1,315,576
Youghiogheny River, Pa	119,428	5
Minnesota River, Minn	666,980	7,281
Big Suamico River, Wis	324	
Black River, Wis	488,748	394
Fox River, Wis	187,816	5,993

[1] No commerce reported.

Table 30. Commerce on Project Waterways, Calendar Year 1954—Continued

[In tons of 2,000 pounds]

Waterway	Tons	Total ton-miles (000 omitted)
Sturgeon Bay and Lake Michigan Ship Canal, Wis. (through traffic only)	1,264,667	
St. Croix River, Wis., and Minn	5,304	121
Channels in Lake St. Clair, Mich	91,096,709	
Clinton River, Mich.[1]		
Detroit River, Mich	119,635,229	
Grays Reef Passage, Mich	5,419,505	
Keweenaw Waterway, Mich. (through traffic) (see ports on)	181,251	
Rouge River, Mich	8,422,486	
Saginaw River, Mich	3,609,397	
St. Clair River, Mich	91,866,105	
St. Marys Falls Canal, Mich	77,071,989	
St. Marys River, Mich	81,809,314	
St. Joseph River, Mich	41,250	83
Calumet-Sag Channel, Ill	3,762,695	
Chicago Sanitary and Ship Canal	14,605,645	
Illinois and Mississippi Canal, Ill.[1]		
Illinois River, Ill	15,354,052	2,838,258
Bodega Bay, Calif	1,653	3
Middle River and connecting channels, Calif	19,645	147
Mokelumne River, Calif	95,330	331
Noyo River, Calif	3,532	4
Old River, Calif	212,126	6,736
Sacramento River, Calif	2,172,451	136,138
San Joaquin River, Calif	2,035,050	70,554
Canals and Locks at Willamette Falls, Oreg	1,597,448	479
Clatskanie River, Oreg	19,492	68
Columbia and Lower Willamette Rivers below Vancouver, Wash., and Portland, Oreg	17,751,099	1,210,001
Columbia River:		
At Baker Bay, Wash	41,131	206
At Bonneville, Oreg	1,372,725	1,373
At McNary Lock and Dam, Oreg., and Wash	527,113	422
Between Wenatchee and Kettle Falls, Wash	224,911	7,817
Mouth to International Boundary (consolidated report)	16,955,099	1,322,811
Vancouver, Wash., to The Dalles, Oreg	3,046,963	123,245
Columbia River and tributaries above Celilo Falls to McNary Lock and Dam, Oreg. and Wash	789,771	66,062
Columbia River and tributaries above McNary Lock and Dam to Kennewick, Wash	527,248	17,024
Columbia Slough, Oreg	44,430	244
Coos and Millicoma Rivers, Oreg	594,678	4,201
Coquille River, Oreg	160,524	1,525
Coquille River, Oreg. (entrance)	161,632	190
Depoe Bay, Oreg	377	
Multnomah Channel, Oreg	792,489	4,755
Nehalem Bay, Oreg	51	
Rogue River, Oreg	1,189	31
Skipanon Channel, Oreg	49,826	96
Smith River, Oreg	49,933	350
Snake River, Oreg., Wash., and Idaho	254,723	622
Suislaw River, Oreg	210,462	1,473
The Dalles-Celilo Canal, Oreg., and Wash	791,192	7,912
Umpqua River, Oreg	510,438	5,615
Westport Slough, Oreg	176,997	124
Willamette River above Portland and Yamhill River, Oreg	4,108,782	101,496
Yaquina River, Oreg	272,025	2,448
Youngs Bay and Youngs River, Oreg	556,783	1,949

[1] No commerce reported.

Table 30. Commerce on Project Waterways, Calendar Year 1954—Continued

[In tons of 2,000 pounds]

Waterway	Tons	Total ton-miles (000 omitted)
Kootenai River, Idaho	1,335	
Chinook Channel, Wash	18,242	2
Cowlitz River, Wash	152,345	804
Deep River, Wash	341,846	1,709
Elokomin Slough, Wash	203,292	207
Grays River, Wash	63,233	316
Hoquiam River, Wash	528,474	4,228
Lake River, Wash	7,871	18
Lake Washington Ship Canal, Wash	2,084,361	
Lewis River, Wash	4,368	4
Puget Sound and its tributary waters [1]		
Quillayute River, Wash	1,278	3
Skagit River, Wash	275,145	3,027
Skamokawa Creek, Wash	24,693	76
Skamokawa Slough, Wash.[1]		
Stillaguamish River, Wash	1,610	10
Swinomish Slough, Wash	637,520	6,375
Waterway connecting Port Townsend Bay and Oak Bay, Wash	284,307	256
Gastineau Channel, Alaska	Not available	
Wrangell Narrows, Alaska	212,139	

[1] No commerce reported.

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